$.296

TRANSACTIONS

OF THE

NORFOLK & NORWICH

NATURALISTS' SOCIETY.

EDITED BY W. A. NICHOLSON, HON. SEC.

The Norfolk and Norwich Naturalists' Society has for its objects:—

1. The Practical Study of Natural Science.

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Page 621, second line, after "W. M. Rankin" add C. E. Moss.

LIST OF THE CONTRIBUTORS

With References to the Articles contributed by each.

PAGE.

ATMORE E. A.—Phytophagous Hymenoptera 810
Hymenoptera [Fauna and Flora of Norfolk] .. 821

BARCLAY F. H.—*Azolla caroliniana* 856

BENNETT A.—Distribution of *Sonchus palustris*, L., and *Atriplex pedunculata*, L., in England 35
Holosteum umbellatum, L., *Statice reticulata*, L., and *Phleum bœhmeri*, Wibel 231
Liparis læselii, Rich. An extension of range 340
Silene otites, *Artemisia campestris* and *Chenopodium botryodes* in East Anglia 343
Note on "Woad" 497
Distribution of *Veronica verna*, L., *V. triphyllos* L., *Herniaria glabra*, L., and *Scleranthus perennis*, L. 528
East Anglian Plants 687
Deschampsia setacea, Richter, a little known Norfolk Grass 694

BIRD M. C. H.—President's Address 627
The Rural Economy, Sport, and Natural History of East Ruston Common 631

BLOOMFIELD E. N.—Lichens of Norfolk and Suffolk [Fauna and Flora of Norfolk] 117
Additions to Hepaticæ [Fauna and Flora of Norfolk] .. 148
Suffolk Fungi 246
The Algæ of Suffolk 768
Marine Algæ 809

BORLEY J. O.—The Poison Apparatus of the Weever 369

BROWNE F. BALFOUR—A Study of the Aquatic Coleoptera and their surroundings in the Norfolk Broads district 58
Ditto (Second Paper) 290
On the Early Stages in the life histories of certain Fresh-water Fishes 478

BURRELL W. H.—*Mertensia maritima*, Gray, in Norfolk 201
Note on a form of *Leucobryum glaucum*, Schp. 537

BUXTON M. L.—Trip to Spain, 1908 667

CATON R. B.—Arrival of Migratory Birds at Great Fakenham, Suffolk 535

CLARKE W. G.—Remains of the Neolithic Age in Thetford district 25
The Classification of Norfolk Flint Implements 215
Notes on the Natural History of Thetford district .. 386
The distribution of Flint and Bronze Implements in Norfolk 393
Norfolk Neolithic Harpoon-barbs and Triangular Knives .. 552
Some Breckland Characteristics 555
A Week in Breckland 677
Bird-life of the Meres 747

PAGE

EDWARDS J.—On *Bagous lutosus*, Gyll., in Norfolk; with some collateral matter 102
Coleoptera [Fauna and Flora of Norfolk] 826
Hemiptera [Fauna and Flora of Norfolk] 840

ELDRED E. J. H.—The Great Bustard 727

EVANS H. M.—Observations on the Poisoned Spines of the Weever-fish, *Trachinus draco* 355

FREEMAN R.—Rotifera [Fauna and Flora of Norfolk] 137

GARSTANG W.—President's Address 1
Natural History of the North Sea 5
Abstract of an Address on Respiration in Sand-burrowing Crabs 22

GELDART A. M.—*Stratiotes aloides*, L. 181

GURNEY EUSTACE—President's Address 155
Limnology or the study of Fresh-waters 159

GURNEY G. H.—Natural History experiences in British East Africa 696

GURNEY J. H.—Note on Wild Geese killed by lightning .. 325
Southern Grey Shrike (*Lanius meridionalis*) in Norfolk .. 352
Note on unusual number of Woodcock 856

GURNEY J. H. and SOUTHWELL T.—Birds [Fauna and Flora of Norfolk] 847

GURNEY ROBERT.—The Life History of the Cladocera 44
Alonopsis ambigua, Lillj., an addition to the Cladocera of Norfolk 150
The Crustacea of the East Norfolk Rivers 410
Estuarine Shells from Ludham 855

HAMOND C. A.—President's Address.. 329
Notes on Blakeney Harbour, past and present 333

HOTBLACK J. T.—Norwich Castle Mound 338

HURRELL H. E.—Notes on *Membranipora monostachys* var. *fossaria*. 498
Notes on the Floscularia of the Great Yarmouth district. 625
Hydra 855

LAVER H.—*Helix pomatia*, L., at Grimston 354

LENEY F.—Some Additions to the Norwich Castle-Museum in 1904 107
ditto in 1905 313
ditto in 1906 458
ditto in 1907 596
ditto in 1908 766

LONG F.—The Salt-marsh Flora of Wells 523
With the British Association at Dublin 684

LONG S. H.—President's Address 499
The Birds of Handa 503

MAYFIELD A.—Non-marine Mollusca [Fauna and Flora of Norfolk] 783

MORLEY C.—Note on Mr. J. Edwards' Paper on *Bagous lutosus*, Gyll., in Norfolk [p. 102] 106
An Entomological visit to Hunstanton 489
The Insects of the Breck 579

NICHOLSON W. A.—A preliminary sketch of the Bionomical Botany of Sutton and the Ant District 265
Proposal for a Botanical Survey of the Broads district .. 618

PAGE

PATTERSON A. H.—Natural History Notes from Yarmouth .. 111
ditto 315
ditto 460
ditto 604
ditto 755
Fishes [Fauna and Flora of Norfolk] 844

PLOWRIGHT C. B.—Note on *Corticium (peniophora) Chrysanthemi*. Plow. 496

PRESTON A. W.—Meteorological Notes, 1904 90
ditto 1905 239
ditto 1906 439
ditto 1907 587
ditto 1908, with Appendix 1898—1907 732

PURDY R. J. W.—The occasional Luminosity of the White Owl (*Strix flammea*) 547

REID C.—Forest-bed Seeds 624

SOAR C. D.—The Hydrachnids of the Norfolk Broads 83

SOUTHWELL T.—Migration other than of Birds, with special reference to the Cetacea 15
Letters from Hamon le Strange and Robert Marsham, F.R.S., preserved at Blickling Hall 175
Notes on the Arctic Whale Fishery from Yarmouth and Lynn 202
Some Old-time Norfolk Botanists 374
Wild-bird protection on the Norfolk Coast 322
ditto 493
ditto 622
ditto 852
A Greater Black-backed Gull killed by lightning .. 326
Obituary Notice of Lieut-Col. Leonard H. L. Irby .. 327
In Memoriam: Professor A. Newton, F.R.S. and Mr. H. Saunders 517

SOUTHWELL T., & GURNEY J. H.—Birds [Fauna and Flora of Norfolk] 847

THOMSON D. G.—Notes on a Tame Hare 540

TURNER E. L.—Some Notes on the Coot and Great Crested Grebe 449

WHEELER F. D.—Obituary Notice of C. G. Barrett 152

WIGG T. J.—Notes on the Herring Fishery of 1904 97
ditto 1905 307
ditto 1906 455
ditto 1907 599
ditto 1908 763

WOODWARD H. B.—The late Samuel C. Sothern 616

LIST OF ILLUSTRATIONS.

	PAGE
Neolithic Implements, Thetford District (to face) ...	25
Scapholeberis aurita (S. Fischer)	45
Daphnia atkinsoni, Baird	47
Camptocercus Lilljeborgii, Schödler (to face) ...	48
Chart showing Sexual Records of Cladocera, etc.	51
Chart showing Mean Temperature of 1903—04 ...	54
Charts of Distribution of Aquatic Coleoptera	64
Norfolk Broads District Map (to face)	69
Study of Avocets (to face)	113
Alonopsis ambigua, Lilljeborg	150
Fruit Heads of Stratiotes Aloides (to face)	185
Leeds Mug	209
Old Blubber House at Lynn	209
Jaw-bone of Whale at the "Ship" Inn, Norwich ...	211
Jaw-bone of Whale at Yarmouth	213
Charts of Collections of Aquatic Coleoptera	293, 295
Norwegian Lobster (*Nephrops norvegicus*) to face ...	319
Maps of Blakeney Harbour (4)	336
Excavation of Castle-Mound (to face)	339
Chart of Cardiac Pulsations, etc. (Poison of Weever Fish)	362
Opercular Bone of Weever Fish	370
Heterotanais Gurneyi, Norman	432
Cyathura Carinata (Kröyer) (to face)	432
Nests of Coots and Grebes (2) (to face)	454
Stages in Life-histories of certain Freshwater Fishes	480, 484
The Great and Little Stack, Handa (to face)	503
Landing Place, Handa (to face)	507
Handa Cliffs (to face)	509
Shags and Guillemots on Handa (to face)	511
Guillemots, Razorbills and Kittiwakes on Handa (to face)	513
Professor Alfred Newton, F.R.S. (to face)	517
Distribution of Marine Plants in Breckland (to face)	572

INDEX TO VOL. VIII.

A

Additions to Norwich Museum, 107, 313, 458, 596, 766.
Africa, Natural History Experiences in British East, 696
Aira canescens, 692
Algæ, Marine, of Norfolk, 809
Algæ, of Suffolk, 768
Alonopsis ambigua in Norfolk, 150
Aquatic Coleoptera in Broad District 58, 290
Arctic Whale-fishery from Yarmouth and Lynn, 202
Artemisia campestris, 343
Atriplex pedunculata, 35
Azolla, 856

B

Bagous lutosus, 102
Barrett, C. G., Obituary, 152
Bird-life of the Meres, 747
Birds of Handa, 503
,, Migratory, Arrival of, 535
,, of Norfolk, 847
Blakeney Harbour, Past and Present, 333
Botanists, Some Old-time, 374
Botany of Breckland, 679
,, Sutton District, 265
Breckland, Botany of, 679
,, Characteristics, 555
,, Flint Instruments, 682
,, Insects of, 579
,, Mollusca of, 678
,, Week in, 677
British Association in Dublin, 684
Broad District, Aquatic Coleoptera 58
Broad District, Hydrachnids of, 83
Broad District, Proposal for Botanical Survey, 618
Bustard, Great, 727

C

Camels, Wild, in Spain, 672
Cetacea, Migration of, 15
Chenopodium botryodes, 343
Cladocera, Additions to Norfolk, 150
,, Life-history of, 44
Classification of Norfolk Flint Implements, 215
Coleoptera of Norfolk, 826
,, Aquatic in Broads District, 58
Coot and Great Crested Grebe, 449
Corticium chrysanthemi, 496
Crustacea of East Norfolk Rivers, 410

D

Deschampsia setacea, Richter, 694
Dianthus prolifer, 690
Diatomaceæ of Suffolk, 775
Distribution of *Sonchus palustris*, 35
Dublin, British Association at, 684

E

Early Stages in Life-history of Fresh-water Fishes, 478
East Africa, Natural History Experiences in British, 696
East Anglian Plants, 687
East Ruston Common, Rural Economy of, etc., 631
Entomological Visit to Hunstanton, 489

F

Fauna and Flora of Norfolk—
Birds, 847
Coleoptera, 826
Fishes, 844
Hemiptera, 840
Hepaticæ, 148
Hymenoptera, 821
,, phytophagous, 810
Lichens, 117
Marine Algæ, 809
Mollusca, Non-marine, 783
Rotifera, 137
Flint and Bronze Implements in Norfolk, 393
Flint Implements of Breckland, 682
Flint Implements, Classification of, 215

Floscularia of Yarmouth, 625
Forest-beds, Seeds from, 624
Fresh-water Fishes, Early Stages in Life-history of, 478
Fresh Waters, Study of, 159
Fungi, Suffolk, 246

G

Great Bustard, 727
Great Crested Grebe, 449
Great Fakenham, Arrival of Migratory Birds at, 535
Grey Shrike (Southern) in Norfolk, 352

H

Handa, Birds of, 503
Hare, Tame, Notes on, 540
Helix pomatia at Grimston, 354
Hemiptera of Norfolk, 840
Herniaria glabra, 531
Herring Fishery of 1904, 97
,, ,, 1905, 307
,, ,, 1906, 455
,, ,, 1907, 599
,, ,, 1908, 763
Holosteum umbellatum, L., 231
Hunstanton, Entomological Visit to, 489
Hydra, 855
Hydrachnids of the Broads, 83
Hymenoptera of Norfolk, 821
Hymenoptera Phytophagous of Norfolk, 810

I J K

Insects of the Breck, 579
Irby, Lt.-Col., Obituary, 327

L

Lake Naivasha, Waterfowl of, 712
Le Strange and Marsham Letters, 175
Letters from Le Strange and Marsham, 175
Leucobryum glaucum, Note on a form of, 537
Lichens of Norfolk and Suffolk, 117
Life-history of Cladocera, 44
Lightning, Wild Geese killed by, 325
Limnology, 159
Liparis loeselii, extension of Range, 340
Lophopus crystallinus, 626
Luminosity of the White Owl, 547
Lynn, Arctic Whale-fishery, 202

M

Mammalian Remains, Sale of, 624
Marine Algæ of Suffolk, 768
Marsham and Le Strange Letters, 175
Membranipora monostachys, 498
Meres, Bird-life of the, 747
Mertensia maritima in Norfolk, 201
Meteorological Notes, 1904, 90
,, ,, 1905, 239
,, ,, 1906, 439
,, ,, 1907, 587
,, ,, 1908, 732
,, ,, Appendix (1898-1907), 739
Migration other than of Birds, 15
Migratory Birds, Arrival of, Great Fakenham, 535
Miscellaneous Notes and Observations, 322, 493, 622, 852
Mollusca of Breckland, 678
Mollusca, Non-marine of Norfolk, 783

N

Naivasha, Lake, Waterfowl of, 712
Natural History of East Ruston Common, 631
Natural History Experiences in British East Africa, 696
Natural History of North Sea, 5
Natural History of Thetford District, 386
Natural History Notes from Yarmouth, 111, 315, 460, 604, 755
Neolithic Age in Thetford, 25
,, Harpoon-Barbs, 552
Newton, Alfred, Obituary, 517
Norfolk—
Bagous lutosus in, 102
Birds, 847
Coleoptera, 290, 826
Crustacea of East Rivers, 410
Fishes, 844
Flint and Bronze Implements, 215, 393
Hepaticæ, 148
Hemiptera, 840
Hymenoptera, 821
,, phytophagous, 810
Lichens, 117
Marine Algæ, 809
Mollusca, non-marine, 783
Neolithic Harpoon-barbs, 552
Rotifera, 137
Wild-Bird Protection, 322, 493, 622, 852

North Sea, Natural History of, 5
Norwich Castle Mound, 338
Norwich Castle-Museum, Additions to, 107, 313, 458, 596, 766
Notes on Arctic Whale-Fishery from Lynn and Yarmouth, 202
Notes on Herring-Fishery, 97, 307, 455, 599, 763
Note on *Leucobryum glaucum*, 537
Notes on a Tame Hare, 540
Notes on Yarmouth Natural History, 111, 315, 460, 604, 755

O

Obituary Notices—
Barrett, C. G., 152
Buxton, C. L., 329
Buxton, H. E., 155
Irby, Lt.-Col., 327
Newton, Alfred, 517
Palmer, F. Danby, 155
Saunders, Howard, 522
Sotheern, S. C., 616
Whitty, C. R., 329
Williams, C., 499
Wright, C. A., 500
Owl, White, Luminosity of, 547

P

Phenological Observations, 1897-1907, 743
Phleum Bahmeri, 231
Plants, East Anglian, 687
Poison Apparatus of Weever-fish, 369
Poisoned Spines of Weever-fish, 355
Presidential Addresses, I, 155, 331 499, 627
Proposal for Botanical Survey of Broads District, 618

R

Remains of Neolithic Age in Thetford, 25
Respiration of Crabs, 22
Rœmeria violacea, 689
Rotifera of Norfolk, 137
Rural Economy of East Ruston Common, 631

S

Sale of Mammalian Remains, 624
Salt-marsh Flora of Wells, 523
Sand-burrowing Crab, Respiration of, 22
Saunders, Howard, Obituary, 522
Sawflies of Norfolk, 810
Scleranthus perennis, 533
Seeds of Forest-bed, 624
Shells from Ludham, 855
Silene Otites, 343
Sketch of Bionomical Botany of Sutton and Ant District, 265
Some Breckland Characteristics, 555
Some Old-time Norfolk Botanists, 374
Sonchus palustris, 35
Sothern, S. C., Obituary, 616
Southern Grey Shrike in Norfolk, 352
Spain, Trip to, 667
,, Wild Camels in, 672
Sport on East Ruston Common, 631
Statice reticulata, 231
Stratiotes aloides, 181
Study of Aquatic Coleoptera in Norfolk Broads, 290
Study of Fresh Waters, 159
Suffolk Algæ, 768
,, Diatomaceæ, 775
,, Fungi, 246
,, and Norfolk Lichens, 117

T

Thetford District, Notes on Natural History of, 386
Thetford, Neolithic Age in, 25

V

Verbascum pulverulentum, 691
Veronica triphyllos, 530
Veronica verna, 528

W

Weever-fish, Poison apparatus of, 369
Weever-fish, Poisoned spines of, 355
Wells, Salt-marsh Flora of, 523
Whale-fishery from Yarmouth and Lynn, 202
Wild-bird Protection in Norfolk, 322 493, 622, 852
Wild Geese killed by Lightning, 325
Williams, Charles, Obituary, 499
Winter and Wild Birds, 469
Woad, Note on, 497
Woodcocks, Unusual number of, 856
Wright, C. A., Obituary, 500

Y

Yarmouth, Flosculariæ, 625
,, Natural History Notes from, 111, 315, 460, 604, 755
Yarmouth, Whale-fishery, 202
,, Winter and Wild Birds, 469

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* Members who have compounded for their subscriptions are marked with an asterisk.

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The Treasurer in Account with the Norfolk and Norwich Naturalists' Society, Year ending March, 1905.

Dr.

1904—5.	£	s.	d.	£	s.	d.
To Subscriptions:—						
1 for 1899—1900	0	5	0			
2 „ 1900—01	0	10	0			
3 „ 1901—02	0	15	0			
10 „ 1902—03	2	10	0			
22 „ 1903—04	5	0	0			
179 „ 1904—05	44	15	0			
5 „ 1905—06	1	5	0			
				55	10	0
„ Additional payments				0	16	0
„ Sale of *Transactions*				5	13	4
„ Transferred from Life Membership Fund				20	2	3
				£82	1	7

Cr.

	£	s.	d.	£	s.	d.
1904. Balance due to Treasurer				5	4	7
1904—5.						
By Fletcher and Son, *Transactions*				53	12	6
„ Ditto Sundry Printing				2	0	6
„ A. H. Goose, Printing and Stationery				2	1	0
	£	s.	d.			
„ Postage, Hon. Secretary	5	4	3			
„ Ditto, Assistant Secretary	0	18	0			
				6	2	3
„ Insurance				0	9	0
„ Year Book of Societies				0	6	0
„ Coc for Lantern at Meeting				1	1	0
„ Norfolk and Norwich Library				1	1	0
„ Doorkeeper at Museum				1	0	0
„ Assistant Secretary's Salary				5	0	0
„ Balance at Messrs. Barclay's Bank				4	3	9
				82	1	7

LIFE MEMBERSHIP FUND.

1904.	£	s.	d.	1905.	£	s.	d.
To Balance from last year	92	18	9	By Transferred to General Account	20	2	3
„ Interest to November 20th, 1904	2	3	6	„ Balance in Norfolk and Norwich Savings Bank ..	75	0	0
	£95	2	3		£95	2	3

Norwich 27th March, 1905.

Examined with vouchers and found correct,

STEPHEN WM. UTTING, *Auditor.*

List of the Publications received by the Society as Donations or Exchanges from March, 1904.

Belfast Naturalists' Field Club. Annual Report and Proceedings. Series II. Parts 1, 2, 3. Vol. v. 1901—04.

Bristol Naturalists' Society, Proceedings of the. New Series. Vol. x. Part 3. Bristol. 1904.

British Association for the Advancement of Science. Report of 73rd Meeting. Southport, 1903. Reports of Corresponding Societies' Committee, 1903 and 1904. Fifteenth Report of Committee on Photographs of Geological Interest in the United Kingdom. Cambridge, 1904.

British Museum.
Economic Zoology. Reports 1, 2.
General Guide.
Guide to Bird Gallery.
„ Shell and Starfish Gallery.
„ Fossil Mammals and Birds.
Blood-sucking Flies and How to Collect them.
From Trustees of British Museum.

Cardiff Naturalists' Society, Transactions of the. Vol. xxxvi. 1903.

City of Norwich, Castle-Museum Committee, Report of the. 1903.

Cleveland Naturalists' Field Club, Record of Proceedings. 1902. Vol. i. No. 5.

Croydon Natural History and Scientific Society, Proceedings and Transactions of the. February 17th, 1903—January 9th, 1904

Ealing Natural Science and Microscopical Society, Report and Transactions. Ealing. 1904.

Edinburgh, Botanical Society of, Transactions and Proceedings of the. Vol. xxii. Parts 1—4. 1901—1905.

France, Bulletin de la Société des Sciences Naturelles de L'Ouest de la. Deuxiéme Serie. Tome i. 1901.

Geographical Journal, The. Including the Proceedings of the Royal Geographical Society. April, 1904—April, 1905.
Presented by Mr. H. G. Barclay, F.R.G.S.

Geologie, Société Belge de, Proces-Verbaux de la. Tome xvii. Fascicules 1—6, 1903. Tome xviii. Fascicules 1—4, 1904.

Glasgow, Natural History Society of, Transactions of the. Vol. vi. (New Series). Part 3. 1901—02

Harvard College, Bulletins of the Museum of Comparative Zoology at. Vol. xxxix. : No. 9, Medusæ from the Maldive Islands. H. B. Bigelow. April, 1904. Vol. xli. : No. 2, The Chimaeroids. S. Garman. March, 1904. Vol. xliii. : No 1, Reports of the Cephalopoda. U. S. Fish Commission, Expedition in charge of A. Agassiz. 1904. Vol. xlv. : No. 2, Development of the Mesonephros and the Müllerian Ducts in Amphibia. R. W. Hall. June, 1904. No. 4, The Maturation, Fertilization, and early Cleavage of *Haminea solitaria* (Say). W. M. Smallwood. December, 1904. Vol. xlvi. : No. 1, Description of Bolca Fishes. C. R. Eastman. June, 1904. Vol. xliv., Geological Series, Vol. vii., The Stone Reefs of Brazil, their Geological and Geographical Relations, with a Chapter on the Coral Reefs, by J. C. Brauner. Cambridge, Mass., 1904. Vol. xlv. : No. 3, The Optic Reflex Apparatus of Vertebrates, etc. Part 1, The Fish-like Vertebrates. Vol. xliii., Nos. 2—3. Vol. xxxiii., Stein-und Hydro-Korallen, 3 plates. Vol. xxxiv., Lagisca irritans, sp. nov. ein Symbiont von Hydro-Korallen. 1 plate, by Emil von Marenzeller. Vol. xlvi. : No. 1, Maldive Cephalochordates, by G. H. Parker. 2 plates. No. 3, Batrachia and Reptilia from the Bahamas. Thomas Barbour.

——— Annual Report of the Keeper of the Museum of Comparative Zoology at Harvard College for 1903—4.

Hull Scientific and Field Naturalists' Club, Transactions of the. 1904. Vol. iii. Part 2.

Ibis, The, A Quarterly Journal of Ornithology. April, 1904—April, 1905. *Presented by Mr. G. F. Burton.*

Lepidoptera of the British Islands. Vol. ix., Heterocera. Geometrina—Pyralidina. By Charles G. Barrett, F.E.S. London, 1904. *Presented by the Author.*

Manchester, Geological and Mining Society. Vol. xxxiii. Parts 13, 14, 15. Session 1903—4.

Manchester Literary and Philosophical Society, Memoirs and Proceedings of. Vol. xlvii. Part 3, 1902—3. Vol. xlviii. Part 2, 1903—4 and Part 3, 1903—4. Vol. xlix. Part 1, 1904—5.

Marine Biological Association of the United Kingdom, Journal of the. Vol. vii. No. 1, April, 1904. No. 2, December, 1904. Index to Vol. vi. (N.S.) 1900—03.
Presented by Mr. Robert Gurney, B.A.

Maryland Geological Survey. Miocene. 2 vols. Text and Plates. Baltimore, U.S.A., 1904.

Microscopical Society, Journal of the Royal. April, 1904 to April, 1905.

Montana, University of. Bulletins. No. 7, Lichens and Mosses of Montana. Announcement for Summer of 1904. Announcement of Inter-Scholastic Meeting, 1904. Register, 1903—4.

Montevideo, Anales del Museo Nacional del. Serie ii. Entrega 1. Flora del Uruguay.

Moscou, Bulletin de la Société Impériale des Naturalistes de. Année 1904. Nos. 2 and 3. Moscou, 1905.

New Zealand Institute, Transactions and Proceedings of the. Vol. xxxvi. Issued August, 1904.

Northamptonshire Natural History Society and Field Club, Journal of the. Parts 97—100. Vol. xii. 1904.

North Staffordshire Field Club. Annual Report and Transactions, 1903—04. Vol. xxxviii.

Northumberland, Durham, and Newcastle-upon-Tyne, Transactions of the Natural History Society of. Vol. i. Part 1. 1904.

Norwich City of, Report of Free Library Committee, 1903—4.

Ornithologist's Club, Bulletin of the British. 65 Nos.
Presented by Mr. H. G. Barclay, F.R.G.S.

Peterborough Natural History, Scientific and Archæological Society. 32nd Annual Report. December 31st, 1903.

Plymouth Institution and Devon and Cornwall Natural History Society. Annual Report. Vol. xiv. Part 1. 1903—4.

Royal Institution of Great Britain. Vol. xvii. Part 2. No. 97. 1905.

Royal Physical Society, Proceedings of the Sessions 1902—04 and 1904—05. Edinburgh, 1904.

Scientific and Learned Societies of Great Britian and Ireland, Official Year-book of the. London, 1904. *Purchased.*

Seal and Whale Fishery in 1904, Notes on the, by Thomas Southwell, F.Z.S. Reprinted from 'The Zoologist.'
Presented by the Author.

Smithsonian Institution, Annual Report of the. Year ending 30th June, 1903. Washington, 1904.
Presented by the Institution.

South London Entomological and Natural History Society, Proceedings of the. 1903.

United States Geological Survey, Professional Papers.

No. 9. Forest Conditions of the Cascade Range Forest Reserve, Oregon. H. D. Langille and others. 1903.

No. 10. Reconnaissance from Fort Hamlin to Kotzebue Sound, Alaska. W. C. Mendenhall. 1902.

No. 12. Drainage Modifications in South-eastern Ohio and adjacent parts of West Virginia and Kentucky. W. G. Tight. 1903.

No. 14. Chemical Analyses of Igneous Rocks. H. S. Washington. 1903.

No. 15. Mineral Resources of the Mount Wrangell District, Alaska. W. C. Mendenhall and F. C. Schrader. 1903.

United States Geological Survey. Water Supply and Irrigation Papers. Washington, 1903.

No. 80. Relation of Rainfall to Run-off. G. W. Rafter.

No. 82. California Hydrography. J. B. Lippincott.

No. 83—85. Report on Progress of Stream-Measurements for 1902. F. H. Newell.

No. 86. Storage Reservoirs on Stony Creek, California. Burt Cole.

No. 87. Irrigation in India. 2nd Edition. Herbert M. Wilson.

Zoological Gardens, Giza, near Cairo. Government of Egypt Public Works Department. Report for 1903.

Zoologist, The. A Monthly Journal of Natural History. March, 1904—March, 1905. *Presented by Mr. G. F. Buxton.*

List of Books presented by W. H. TUCK, Esq.

Ants, Account of English. Rev. W. Gould. 1777.

Ants, Natural History of. J. E. Johnson. 1820.

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ADDRESS.

Read by the President, WALTER GARSTANG, M.A., F.Z.S., *to the Members of the Norfolk and Norwich Naturalists' Society, at their Thirty-sixth Annual Meeting, held at the Norwich Castle-Museum, March 28th*, 1905.

LADIES AND GENTLEMEN—It is the first duty of your President, on the expiration of his year of office, to review the proceedings of the past year and to present a statement of the changes which have affected, or are likely to affect, the welfare of the Society, and the promotion of the objects which it has at heart.

We have regretfully to record the death of four members, the Rev. Henry Wimble, the Rt. Hon. Lord Hastings, Mr. Charles Southwell, and Mr. C. G. Barrett. An obituary notice of Mr. Barrett has been prepared for the Transactions.

Four members have resigned, and there are about six others who have not paid any subscription for some years, and presumably do not wish to continue their membership. The total number of members is about 270.

Special mention must be made of a number of valuable donations to the Society during the past session. Dr. M. C. Cooke has sent copies of a number of his works. Mr. W. H. Tuck has presented all his books dealing with Natural History, numbering over 100. Colonel Irby has given the Society several valuable works on Ornithology, with a promise of more in the future. It was at first Colonel Irby's wish that the Castle-Museum Library and our own should be amalga-

mated. In view of the difficulties of such an amalgamation, Colonel Irby has decided that we should receive at least a considerable number of his books. Separate lists of all these books will be printed in the Transactions under the names of the donors.

The Society will also value Sir Joseph Hooker's gift of a portrait of Dawson Turner, F.R.S., from an etching by Mrs. Turner of a drawing by J. S. Cotman of Norwich.

Mr. H. G. Barclay, F.R.G.S., continues to present us with the 'Geographical Journal' monthly, and Mr. G. F. Buxton with the 'Ibis' quarterly, and the 'Zoologist' monthly.

The list of Societies with which we exchange Transactions, etc., increases annually, and now amounts to more than 50.

The attendance at the evening meetings has been, I am informed, a little above that of previous years.

On April 26th, 1904, Mr. T. Southwell, F.Z.S., read a paper on "Migration, with special reference to the Cetacea," and Mr. A. Patterson contributed some Notes on local Natural History.

On May 31st, a discussion on "Melanism in Moths" was introduced by the Rev. A. Miles Moss, and Dr. Wheeler, Mr. F. C. Hinde, Mr. H. J. Thouless, and others took part.

In August I attended, as delegate of the Society, the meeting of the British Association at Cambridge. At the first Conference of Delegates of Corresponding Societies, the Chairman, Principal E. H. Griffiths, F.R.S., discussed in his address the proposals made by Sir Norman Lockyer, as President of the previous meeting of the Association at Southport, for bringing about a more effective organisation of scientific workers and persons interested in science, in order to provide a means of pressing upon the central authorities, as well as upon local councils and committees, the "urgent need of better education in science, as well as of more scientific education." Sir Norman Lockyer suggested that the nucleus of such an organisation already existed in the British Association, which served as

a "Scientific Parliament," and in the Corresponding Societies, which might be regarded as local machinery.

Accepting in general Sir Norman Lockyer's proposals and the national urgency of the object aimed at, Mr. Griffiths justly considered that the present bonds between the affiliated societies and the Association were too loose for the purpose. "If we could supply the links," he said, "which would bind together all the Scientific Societies of this kingdom, so that in matters of national importance they would move as a united body, it would be difficult to overestimate the influence which could be thus exerted, for it is certain that amongst the members of these local Societies are included many of the most intelligent and influential men in their respective districts. At present, however, apart from their interest in natural science, these local Societies have little in common."

Proposals were made for revising the conditions under which local Societies were affiliated to the Association; but at the second Conference of Delegates it was unanimously decided to support the Chairman in applying for the appointment of a special Committee, consisting of members of the Council of the Association, together with representatives of the Corresponding Societies, to consider the present relation between the British Association and local Scientific Societies, and to make recommendations to the Council accordingly.

In view of the remarks on this subject made by my predecessor, Mr. Long, at our last annual meeting, I have thought it desirable to inform the Society of the tendency of more recent developments. There can be little doubt that, apart from the primary and important object of the present movement, a closer federation of local Societies would tend to promote the studies in which they are all concerned, especially by encouraging co-operation in the investigation of particular problems and the adoption of more complete and uniform methods in the registration of natural history phenomena.

On September 27th, Mr. F. Balfour Browne, M.A., F.Z.S.,

exhibited two uncommon Insects from the Broads District, and the President described a number of experiments which he had made at the Plymouth Laboratory in order to discover the means by which burrowing Crabs carry on the process of respiration when submerged in sand. These were illustrated by lantern slides.

On October 25th, Mr. F. Balfour Browne read a paper on "The Significance of the Smolt stage in the Salmonidæ," and exhibited a most interesting series of photographs illustrating stages in the life-history of the Salmonidæ.

On November 29th, the Rev. J. A. Laurence described a remarkable growth of Fungi found in a cellar; Mr. F. C. Hinde read notes on "The Lepidoptera of the New Forest"; and Mr. A. Patterson contributed further observations on local Natural History.

On January 31st, 1905, Mr. W. G. Clarke read a paper on "Neolithic Remains in Thetford District"; Mr. H. J. Thouless exhibited three specimens of different Beetles, hitherto unrecorded for Britain, recently captured in Norfolk; Mr. A. Bennett, F.L.S., contributed a paper on "*Sonchus palustris*, L. and *Atriplex pedunculata*, L."; and the Rev. E. N. Bloomfield sent a list of Lichens of Norfolk and Suffolk, and a supplementary notice of Norfolk Hepaticæ.

On February 28th, Mr. Robert Gurney, B.A., gave an account, illustrated by lantern slides, of "The Life-history of Cladocera"; and Mr. F. Balfour Browne read a paper on the "Aquatic Coleoptera of the Broad District." Other papers brought forward were:—"The Water-mites of the Broad District," by Mr. C. D. Soar, F.R.M.S., communicated by Mr. F. Balfour Browne; "A Refutation of a certain Statement in Vol. vii., p. 720, of the Transactions," by Mr. James Edwards, F.E.S.; "Notes on the Herring Fishery, 1904," by Mr. T. J. Wigg; "Meteorological Notes, 1904," by Mr. A. W. Preston, F. R. Met. Soc.; and "Norfolk Rotifera," by Rev. Richard Freeman.

I have selected as the subject of my address—

THE NATURAL HISTORY OF THE NORTH SEA.

Although our Society is primarily concerned with the fauna and flora of Norfolk, it requires little argument to show that the characteristic features presented by a given area cannot be adequately estimated until they have been compared with those of neighbouring areas. Comparative methods of study are particularly necessary in the case of Marine Biology, owing to the absence of obvious barriers to the dispersal of marine organisms, our relative ignorance of the factors which determine distribution, and the difficulties which confront all efforts to expose the conditions of existence for species which live below the tidal zone, beyond the reach of direct observation.

Assuming that we possess a fairly complete knowledge of the coastal fauna of a given area, it is impossible to understand the causes of the observed distribution, to know why one species is rare and another abundant, or why a given species attains a larger size in a neighbouring district than in our own, or *vice versa*, until we know what are the dominant influences at work in adjacent waters, and are able to distinguish between those which are regular and normal and those which are irregular and of less frequent or less powerful character.

The history of Marine Biology may be said to have passed through the following stages: firstly, the pioneer investigations of individual naturalists, such as Otto Müller and Sir John Dalyell, who laid the foundations of later knowledge by describing in comprehensive manner the local fauna of particular portions of the coast; secondly, the period of the monographers such as Forbes, Gosse, Alder and Hancock, Allman, Hincks, and McIntosh, who took up the study of special groups, gave precision to vaguely described or previously unrecognised species, and summarised the knowledge of the time concerning their distribution and habits of life; thirdly, the period of

special expeditions, organised from time to time by societies and academical institutions, and sometimes by Governments, such as the dredging expeditions of the British Association under Forbes and MacAndrew, the voyages of the "Lightning" "Porcupine," and "Challenger," under Carpenter and Wyville Thomson, the Norwegian North Atlantic Expedition, and the North Sea Voyage in 1872 of the German "Pommerania"; and fourthly, the period of marine laboratories, of which in English waters the stations at Plymouth, St. Andrews, Port Erin, and Millport are well known, and find their counterpart on the continental coasts of the English Channel and North Sea in the well-equipped establishments at Roscoff, Wimereux, Helder, Heligoland, and Bergen.

There are thus many sections of the coast-line of North-western Europe where local investigations in Marine Biology can be carried out with the facilities necessary for modern research, although the absence of a permanent laboratory on the East Coast of England, where naturalists can find the equipment necessary for a month's or a summer's research, constitutes a serious deficiency which, with Mr. Southwell, I hope will be remedied at an early date by East Anglian enterprise.

Within recent years Marine Biology has entered upon a new phase, mainly brought about by the great development of the sea fisheries and the problems concerning the maintenance of the supply of fish to which that development has given rise. A great amount of knowledge bearing upon the natural history of our sea-fishes has been accumulated by the workers at our marine laboratories. The eggs, larvæ, and young stages of the various species have, with few exceptions, been identified and described; the size at which maturity is reached has been approximately determined in many cases; the relative fecundity of many species has been ascertained; a good deal is known concerning the habits of those species which frequent the shallower waters; and last, but not least,

erroneous notions have been dispelled on many matters, even though fuller knowledge is required before durable conclusions can be substituted in their place.

The one thing which our laboratories could not supply was a detailed knowledge of the off-shore fishing grounds; for that was a matter, as Professor Herdman has aptly expressed it, of "ships, and men, and work at sea," and consequently beyond the normal resources of our existing institutions. Yet without that knowledge much of the information that had already been acquired was of little use in its bearings upon the broader problems of practical importance. The facts stood isolated: the intermediate links were missing. And confronting the idea of a serious exploration lay the hard obstacle which the mere size of the sea opposed; what could a single ship do in an area so large? "A great deal" would be a fairly correct answer under certain circumstances, but a better solution has been furnished by the actual progress of events.

More accustomed than Englishmen to international enterprise, the continental investigators were the first to suggest international co-operation as a means of coping with the practical difficulties of a systematic survey of the North Sea. For hydrographical purposes the Swedes had already succeeded in 1893 in bringing about an international survey of the northern part of this area, and in fishery matters an International Commission on the Salmon Fisheries of the Rhine had for a number of years accustomed the representatives of various countries to act together for the advancement of a common aim. In 1893 an English Parliamentary Committee urgently recommended international treatment of the Undersized Fish question; and in the following year, Dr. Heincke, the Director of the German Laboratory at Heligoland, impressed with the evidence adduced before that Committee, urged the necessity of international investigations as the only effective means of coping adequately with the same problem.

These various currents ultimately fused, with the result that in 1899 a preliminary conference of delegates of the North

Sea States met in Stockholm on the invitation of the Swedish Government to draw up a programme for a hydrographical and biological survey of the North Sea and adjacent waters in the interests of the sea fisheries. A revision of the programme took place at Christiania in 1901, and was subsequently accepted by all the Governments represented, including Norway, Sweden, Russia, Finland, Germany, Denmark, Holland, Belgium, and Great Britain. In the following year an International Council was constituted with its headquarters at Copenhagen ; the various agencies were appointed for carrying out the work ; and most of the countries concerned had begun their part of the investigations at sea before the close of the same year.

The scheme of investigation may be outlined as follows. The North Sea and adjacent waters which influence it, including the Baltic Sea, English Channel, and the Norwegian Sea as far west as Iceland, were divided up into districts for exploration by the vessels of the participating countries, on the general principle that each country would undertake those sections of the entire area which bordered upon its own territory. Once a quarter each vessel was to make a hydrographic cruise along predetermined lines in the months of February, May, August, and November, for the express purpose of sampling the physical and biological characters of the waters of each region, including the temperature and salinity of the water at successive depths and the nature and relative abundance of the floating organisms (plankton) present at each station. The intervals between these cruises were to be occupied with trawling and other investigations bearing primarily upon the distribution, migrations, reproduction, and rate of growth of fishes, as well as upon the bottom fauna and flora in general. During the first three years the biological work was to be concentrated as far as possible upon the acquisition of data bearing upon the problems of "over-fishing," and of the migrations of Cod and Herring.

For two years now this work has made steady, if silent, progress ; and, when the time arrives for collecting the results obtained, I believe they will be found not only to have greatly broadened the basis of our knowledge, but to entail a complete revolution in the points of view from which many general problems have hitherto been regarded. At present I can merely give a few examples of the methods employed and of some of the earlier results of the work accomplished.

The hydrographic results are based on the serial observations and samples collected at fixed stations on the periodic cruises at successive depths, supplemented by a net-work of observations of surface temperature made on board trans-Atlantic and North Sea steamers making regular voyages between particular ports, as well as by the analysis of a large number of samples of surface water collected by officers of the same vessels. Surface observations of this kind have been found to yield valuable material when checked by the results of the more complete and exact data obtained on the special hydrographic cruises, and serve in many cases to bridge the gaps that would otherwise separate the hydrographic stations from one another.

It has been recognised for some time that the North Sea is not a uniform mass of water, but a more or less imperfect mixture of waters derivable from Atlantic, Arctic, and Baltic sources. The Atlantic current is twofold, one branch entering the North Sea by way of the English Channel, the other round the north of Scotland. There is a difference of temperature between these two streams, but both are warm and highly saline. The Baltic stream is largely fresh water. It attains its maximum volume during the spring months in consequence of the melting of the snows on the watersheds of northern Europe, and is then ice-cold ; in summer, on the other hand, its waters becomes strongly heated. In consequence of its low specific gravity it flows through the Cattegat and Skager-Rak as a surface stream overlying the salter waters in the depths. Water of Arctic origin covers

the greater depressions of the bed of the North Sea, while the intermediate depths are covered with a mixture of Arctic, Atlantic, and Coastal waters, in which apparently the cold Arctic influences may predominate in one year and those of the warm Atlantic in another.

The possible bearings of such differences as these on the fluctuations observed in the abundance of the more migratory fishes are open to the imagination. It is still more important to observe that the investigations of the past few years have placed the reality of these influences beyond all doubt. The first results have naturally been attained in regions where the characters of the conflicting currents are sharply contrasted, as for example, in the neighbourhood of the Scandinavian coast, where the Baltic current of brackish water and the salt Atlantic flood come together, and in Icelandic waters where the Atlantic stream meets the cold Polar currents.

To the English naturalist, accustomed as he is to the uniformity of the sea in the neighbourhood of the British Isles, these names convey but little meaning, and to claim that they represent realities whose influence upon animal life is radically different—even to the point of life and death—savours almost of the fictitious. Yet there is no exaggeration. If you see a net lowered, as I have done, in the Great Belt, or the Cattegat or Christiania fjord, you will see that the catch in the surface waters is profoundly different from that in the depths, and that, when the net is raised from the bottom layers, the Medusæ and Ctenophores and other salt-water species have been killed or paralysed by their passage through the superficial layers of brackish water.

Similarly the Norwegian investigators have found that in those years when prolonged westerly winds in the spring months have checked the outflow of the Baltic current from the Skager-Rak, and banked up the Atlantic water against the coast, the Herrings come close inshore, within the island belt, to spawn, and a great fishery results; whereas in other years, when the Baltic current is deep and wide, its cold waters

flow northwards along the coast, and cover the shallow spawning grounds with cold and brackish water from top to bottom. Under such circumstances the Herrings stop far out, and spawn in deep water inaccessible to the fishermen, with the result that the fishery is a failure.

More recently the Danish investigators have shown that in the neighbourhood of Iceland, the Cod only spawn in spring in the Atlantic water on the southern side of the island, and that at the same time spawning Cod and the floating eggs of the Cod are quite absent from the Arctic waters on the northern and eastern sides, although young and spent fish are caught there later in the year when the warm Atlantic current has spread around the western and northern coasts of the island. This eastward migration of the Cod in relation with the eastward expansion of the Atlantic stream in summer is also shared by the Herring at the same season.

It is clear that the parallel study of the physics and biology of the sea is providing us with a clue to the explanation of many of the hitherto inexplicable irregularities in the multiplication and wanderings of our sea-fishes. The conditions in the North Sea proper appear to differ from those in the border regions which have been discussed merely in the greater complexity of the factors concerned. Instead of two sharply contrasted streams, the North Sea consists of five or six masses of water of different origin, the distinctive characters of which are so quickly attenuated by mixture, or masked by coastal influences, that the investigation of the dominant influences at work presents difficulties of a special kind. Such results as those which have been mentioned are sufficient, however, to satisfy us that we are on the right road of inquiry, and that the steady prosecution of the work at sea, combined with the gradual perfection of our methods of experiment and observation, will produce their fruits in due season.

One feature already made clear by the hydrographic investigations is that the Atlantic current, the time-honoured Gulf Stream, is not a constant, but a seasonal stream—a

summer expansion of the great Atlantic eddy which circulates round the Sargasso Sea. The full effects of this periodic flood of warm salt water appear to be felt off the coasts of the North Sea as a rule in the autumn months, and to cause the seas on the coasts of Holland, Germany, and Sweden to reach their highest average level at this season of the year. Various phenomena connected with the migrations and spawning of important food-fishes, in addition to the examples already given, appear to be dependent on this periodic inflow of Atlantic water ; while variations in its volume and course from year to year appear to be correlated with significant changes in the distributions and migrations of fish.

Professor McIntosh has already drawn attention to the numbers of oceanic species of Coelenterate and other types which stream southwards along the East coast of Scotland during the summer months. I shall be much surprised if our investigations do not ultimately reveal a close relation between good and bad Herring seasons off the East Anglian coast and the annual fluctuations in the volume and character of this North Sea eddy from the Atlantic flood.

Referring now more particularly to the English work in the North Sea under the international programme, I may say that the Marine Biological Association have naturally devoted most time during the first two years to the investigation of flat-fish problems. The migrations of Plaice have been studied by attaching numbered labels to the fish and setting them free in various localities. This method has proved a very fruitful one, and has enabled us already to form a picture of the seasonal migrations of Plaice in the south part of the North Sea, which in its essential features will probably be established as representing the normal sequence of events. Speaking broadly, the Plaice along the Dutch and Belgian coasts seem to display a general tendency in a north-westerly direction towards the more open waters of the North Sea during the spring and summer months ; while, during the same period, Plaice on the Dogger Bank seem to be fairly stationary.

On the approach of winter the fish on the Dogger Bank seem to scatter radially in all directions, and a fairly general southward movement is evinced in the area south of the Bank. So great is the disturbance of the sea bottom during these winter gales on the shallower central grounds such as the Dogger and Well Banks, that the Hydroid Zoophytes, which are so abundant in these localities, are rolled by wave-action into compact fibrous balls from 4 to 8 inches in diameter. [Specimens of these "Surf-balls" were exhibited, consisting of *Obelia longissima* on the Dogger Bank, and of *Hydrallmania falcata* and *Sertularia abietina* on the Well Bank.]

The growth of Plaice has been shown by the transplantation of small marked fish to be three or four times as rapid on the Dogger Bank as on the shallow coastal grounds which form their natural habitat, a difference of great scientific as well as practical interest.

The investigation of the age of fishes has been greatly facilitated during recent years by the discovery that the concentric markings exhibited by the scales, otoliths, vertebræ, and other skeletal structures are merely expressions of the annual periodicity of the growth of fishes, like the rings seen in the section of a tree. The study of the otoliths of Plaice of different size from various localities has already enabled us to compare the rate of growth on various coastal grounds with great exactitude.

Some results of the trawling investigations in the neighbourhood of the Norfolk coast will doubtless interest the members of the Society. It has been found in nearly all localities that the abundance of small Plaice steadily decreases with increasing depth and distance from shore. The distribution of Plaice between the Norfolk coast and the Dogger Bank furnishes a remarkable exception to this rule, as small plaice have been found to be much more abundant on the Leman Ground, 50 miles from shore, than among the intervening banks nearer the Norfolk coast. On the other hand, the normal conditions prevail between the Leman Ground and the Dutch

coast. In fact, all along the English coast small Plaice are far less plentiful than on the continental grounds. It is customary to explain the latter fact as a consequence of the eastward drift of the floating eggs, but this explanation does not appear to fully cover the facts. The bottom deposits are very different on the opposite sides of the North Sea, and their character exerts a profound influence on the distribution of the invertebrate forms which serve as food for fishes, as well as upon the distribution of the fishes themselves. On the continental coast the bottom consists of fine sand, but along the greater part of the English coast the bottom consists of coarse sand and gravel. The former is favourable for the development of burrowing bivalves, which form the chief food of Plaice; but coarse sand and gravel are highly unfavourable. The prevalence of these coarse deposits off the English coast appears to explain the relative dearth of small Plaice inshore, as well as among the outlying banks off the Norfolk coast, while the large numbers of small Plaice found on the Leman Ground further off, must be mainly derived, not from the English shores, but by emigration from the Dutch coast—a result which is in agreement with the experimental evidence afforded by the marked fish.

In conclusion, Ladies and Gentlemen, I have been able to give you but a rough sketch of the investigations in progress. I shall not have failed altogether, however, if I have conveyed a fair outline of the methods which are being employed in this last attempt to unravel the mysteries of the sea around us. When you reflect that work is being conducted on similar lines on behalf of every country bordering upon the North and Baltic Seas, you will realise, I think, that the Governments concerned have embarked upon a historic enterprise, which is calculated in due course to yield durable results concerning the natural conditions which control the supply of fish in the North Sea and man's power to modify them to his advantage. In this, as in other departments of human activity, knowledge alone can bring such power.

I.

ON MIGRATION OTHER THAN OF BIRDS, WITH SPECIAL REFERENCE TO THE CETACEA.

By Thomas Southwell, F.Z.S., V.-P.

Read 26th April, 1904.

The study of the group of phenomena associated with migration, for the observation of which we, in this the most easterly extension of the British Isles, are so favourably situated, has from the earliest times attracted the attention of thoughtful observers; but it is only within the experience of many now living that they have been studied by scientific methods, and till recently the observations have been almost entirely restricted to the arrival and departure of birds. The equally interesting movements of the marine mammals and fishes frequenting the waters which lave our shores have attracted very little notice further than that evinced by the fishermen who have regular seasons for their capture. "Calendars" recording the arrival and departure of birds and other kindred natural phenomena have been compiled without number; by far the most remarkable of which is that kept for the last one hundred and seventy years by the Marsham family in our own neighbourhood; but I venture to think they are more curious than useful—something far more comprehensive is required to constitute records of any material value, and I think I shall be able to show, although I may have to travel further afield than our own immediate neighbourhood, that avine migration is not the only branch of this difficult subject which is worthy of our study.

The first really useful step in the right direction was taken

by our friend Professor Newton in conjunction with his brother Edward, and speedily led to the interesting discovery that the common Song Thrush is a migratory species. Since then it has been established that there is hardly a sedentary species of bird found in the British Isles, and that all are subject to migratory movements to a greater or less degree, and strange as it may seem, one of the most pronounced migrants is the tiniest of all our indigenous birds, the Gold Crested Wren.

Much has been done by British and Continental observers to throw light upon the periodic movements of birds and the routes followed by them, and Mr. Eagle Clarke has spent months immured in lighthouses, or tossing in the light-vessels off our coast, in pursuit of such information, and in addition, who can say how many midnight hours he has devoted to analysing the results of his own and others' observations ? We know that although in many cases they are highly complicated, the main routes of migration are in spring towards the north and from west to east, and in autumn from north to south and east to west ; but here our knowledge stops. We look at the clock and see the time clearly indicated by the revolving hands, but this gives us no clue to the nature of the machinery hidden behind the dial which propels those hands, so, although we may have learned much as to the seasons and direction of their journeys, the cause which prompts these migratory movements, and the wonderful faculties which lead the birds on these often protracted and always perilous journeys are still very largely matters of conjecture. Efforts to solve the mystery have been many, and it is possible that there are grains of truth scattered here and there in the mass of theory that has been advanced, which may at some future period aid in solving the problem ; but at present wise men fear to tread where their more ardent, if not better informed brethren, rush in, and we can only at present veil our ignorance by the use of a term which has never yet been satisfactorily defined, and attribute the wonderful phenomena to inherited "instinct."

We are so accustomed to associate the phenomena of migration with Birds that we are apt to overlook the fact that this division of the animal kingdom has by no means a monopoly of these functions, and that they are shared to a remarkable degree by many both terrestrial and aquatic animals. Although the apparently trackless path of the bird in the air is unique of its kind, there is also to be solved the initial impulse which impels Anadromous fishes, as the Salmon family, to leave the sea for fresh water in which to propagate their species, and guides their offspring on their return to the waters in which they passed the early stages of their existence, or on the other hand prompts Catadromous fishes, like the Eel, to do precisely the reverse. We are all familiar with the herding together at certain seasons of vast shoals of Herrings, Pilchards, Sprats, or Mackerel, but we were not prepared for the wanderings of the common Plaice which have lately been revealed, and I doubt not the systematic investigations of the International Marine Biological research now proceeding will have many strange facts to acquaint us with, and that the wanderings of the Pleuronectidæ, hitherto regarded as a very sedentary family, will not be found to be aimless.

And this opens up a question of fresh interest—the actual extent of these migrations. I shall endeavour to show that they are much more limited than has generally been supposed with regard to certain marine mammals, and I doubt not this is also the case with the migratory fishes. I can here only refer you to the investigations of our President, Mr. Garstang, with regard to the Mackerel,* wherein he clearly shows that there are certain well marked races of this fish, which, for reasons he duly sets forth, do not intermix, that each race never wanders far from its normal locality, and that they are as truly local in their wanderings as the Salmon of particular rivers. Eleven years ago Mr. Stacy Watson, in a paper read before this Society on the "Varieties

* 'Journal of the Plymouth Marine Biological Association,' vol. v. Nov., 1898, p. 235.

and Distribution of the Herring" arrived at very similar conclusions with regard to that fish.*

There are many puzzles connected with the terrestrial mammalia, such as the occasional flocking together of vast numbers of Lemmings and the sudden invasions of Field Mice, which are waiting intelligent solution, although their bearing on the subject of migration is only indirect; but when we turn to the marine mammalia we find the phenomena of migration in operation to their fullest extent. I need only briefly refer to the fact of the gathering together of the Eared Seals in vast numbers on the islands in Bering Sea, or to the still vaster congregations of true Seals on the ice floes in the Gulf of St. Lawrence and off the east coast of Newfoundland, the object of both being to form shore nurseries for their young, but must hasten to speak of the purely aquatic family of Cetacea, and I think it may be said that from the giant Sperm Whale to the smallest Dolphin, so far as their habits have been investigated, they all come under the denomination of migrants. But here again there is reason to believe that with perhaps the exception of certain Ziphioid Whales, even these are not such great wanderers as has generally been supposed. It is the opinion of some that even the Sperm Whales of the Tropics are distinct from those, say, frequenting the Japanese Seas, and those who deal commercially with their products recognise a difference in their qualities; it is also believed by some that the Sperm Whales which occasionally stray to our shores are derived from a race inhabiting the North Atlantic. How far this may be the case I am not in a position to venture an opinion, but reasoning from analogy it is far from impossible.

One of the most regular marine migrants is the Bottle-nose Whale (Hyperoodon), which visits our shores almost every spring going northward, where it congregates in small flocks and spends the summer in the Greenland Seas, again visiting us on its return south in autumn, the old females frequently accompanied by their single young one, the males, as is often the case during migration, separating from the females and

* 'Transactions' (1894) vol v. p. 584.

adopting some other route (possibly more to the westward) so as to be quite unknown to us in the adult stage. Precisely where they pass the winter months is still a matter of uncertainty, and these remarks will apply equally to the White-beaked Dolphin, another typical migrant belonging to this order.

With the active prosecution of the Fin Whale fishery on the Norwegian coast and in the Newfoundland waters, our knowledge with regard to the habits, distribution, and seasonal movements of the Balænopteridae has been greatly increased, and it has been found that vast as is the range of the species comprised in this family, its individual members are not by any means such erratic wanderers as they have been generally regarded.* Their line of migration is from south to north on each side of the Atlantic, and although they are specifically the same, it is extremely probable that under normal circumstances no interchange takes place between those inhabiting respectively the eastern and western sides of that ocean: indeed, Dr. F. W. True, who in his monograph of the Whalebone Whales of the Western North Atlantic has treated the subject with the thoroughness which characterises all his work, shows that the Newfoundland Whales differ in some respects from those killed by the Norwegians, and are smaller, species for species, in all their proportions, the reasonable conclusion being that the east and west sides of the Atlantic respectively are frequented each by a distinct race of the same species.

If we turn to the Whales of the genus Balæna, of which, probably, there are only two species, but several races, we find the popular belief expressed even in the present day by some writers of repute that the Whale hunted in very early times by the Basques in the temperate waters of the North Atlantic has by constant persecution been driven north into the Polar Seas, whereas nothing can be further from the truth;

* The Californian Gray Whale (*Rachianectes glaucus*. Cope) is a typical example: it is restricted to the Pacific Coast of North America, according to Scammon, wintering not lower than 40° North Latitude and migrating in summer as high as the Arctic Circle.

it has been clearly demonstrated by Professors Eschricht and Reinhardt that such has not been the case. This animal, known as the Atlantic Right Whale (*B. biscayensis*), has, it is true, become very scarce in recent times, but is still met with on rare occasions in precisely the same regions as formerly—from which it may be exterminated but can never be driven,—and it performs its seasonal migrations with the same regularity, frequenting the waters of the Bay of Biscay and the Mediterranean in winter and the seas in the neighbourhood of Cape Farewell, eastward to the North Cape, in summer. Whether the Whale known as *B. australis* is specifically the same, although probable, is not universally admitted; if, however, such is the case, the range as a species is vastly more extensive; but in that case it will most likely prove that the southern form is racially distinct, and that each is restricted to its own somewhat limited area. It is certain that any true Balæna which has occurred on our coast belonged to this species.

The Polar Right Whale is another typical migrant. It would occupy too much space here to enter into particulars as to its annual movements, and I have already done this somewhat fully in another place,* with the result that instead of this species being circumpolar and unrestricted in its movements, I have endeavoured to show that there are three distinct races, each inhabiting a separate area, namely Davis Strait to the west of Greenland, the Greenland Sea proper, and the seas north of Bering Strait, that within these limits each race performs its somewhat complex migrations north and south, and that they rarely if ever intermix; also, that instead of being circumpolar in the usual acceptation of the term, between those inhabiting Davis Strait and the Greenland Seas lies the whole width of the continent of Greenland, the southern extremity of which they never pass, and between 20° East Longitude and 171° East, no Whales are known to be found. We then reach the habitat of the American Bowhead, the range of which to the eastward extends to the Polar

* "The Migration of the Right Whale." 'Natural Science,' vol. xii. pp. 397-414.

Archipelago, the intricate channels of which there is no evidence to show they pass through to join their brethren in Baffin Bay. The views here expressed are strengthened by the fact that between the years 1897 and 1900 only three Right Whales were seen by the Whalers in the seas to the east of Greenland, two of which were killed, and since the latter year no Scotch vessel has visited these seas which formerly swarmed with these valuable animals, and it is only too probable that they have been exterminated in this vast expanse of ocean. Had there been any communication with Davis Strait, where Whales are still plentiful, this could not have been the case.

I have endeavoured here to show how universal these periodic movements, which we are accustomed to designate as "migration," are, and that they are by no means confined to creatures endowed with the powers of flight—also that just as the same individual birds do not extend their migratory journey over the whole area in which the species occurs, but pass in relays, those spending the summer in the extremest north not going so far south in winter as those breeding in more southerly localities, some of our familiar birds which are apparently sedentary species and with us the year round not being represented by the same individuals at all seasons—so the various races of fishes and marine mammals do not cover in their migrations the whole area in which the species is found, but in all probability are much more restricted in their movements than is generally supposed.

N.B.—This Paper was read before the Society in April, 1904, but part of the MS. having been lost, the opportunity has been taken to embody an important result of Dr. True's study of the Fin Whales of the north-west Atlantic, which had not then been published.—*T.S.*

II.

ABSTRACT OF AN ADDRESS ON RESPIRATION IN SAND-BURROWING CRABS

Delivered 27th September, 1904.

At the September meeting of the Society, the President (Mr. W. Garstang, M.A.) described a number of aquarium experiments which he had made with Crabs of various species at the Plymouth Laboratory, in order to discover the means by which burrowing forms carry on the process of respiration when submerged in sand.

The gills being enclosed in a pair of chambers, the narrow entrances to which are situated on the under-side of the body, it had not previously been clear how the Crabs could draw up a sufficient supply of water, free from particles of sand and mud, when their bodies were immersed below the sea-bed.

It was found experimentally that in many cases the claws, together with the marginal spines of the shell, played an important role in this connection. In the common Shore-crab, and in all the Swimming Crabs (*Portunidæ*), the legs bearing the claws are well known to be so shaped that when flexed against the Crab's breast they follow its curvature and fit it exactly. The narrow gap between them and the breast of the Crab is roofed over by the row of marginal spines on the shell, the number of which varies in different species, but the extent of which always corresponds with the length of the gap between breast and claw. The row of spines and the notches between them were found to serve the purpose of a sieve or grating, while the water for respiration did not pass directly into the gill-chamber through the ventral aperture, but was sucked downwards through this sieve, being guided

to the ventral aperture through the gap between claws and breast. Thus Crabs which conceal themselves just below the surface of the sand were enabled to draw their water with relative ease from the general reservoir above them.

In many exotic types, known as Box-crabs from their habit of "shutting-up," the sides of the shell were smooth and devoid of filtering spines, but the same purpose was clearly discharged by crest-like expansions, divided into spines and notches on the upper edge of the claws themselves. The Mediterranean *Calappa* is an example of this type.

In other cases in which the Crabs bury themselves deeply below the surface of the sand, as in the Masked Crab (*Corystes*) of the English coasts, the claws are not utilised at all for respiratory purposes, and are not adapted to the curvature of the shell. But the antennæ are remarkably long and fringed with a double row of curved hairs, which by juxtaposition constitute a regular supply pipe reaching to the top of the sand in which the Crabs lie buried. By a reversal of the normal mode of breathing the Crab sucks its supply of water down this antennal tube into what, in other Crabs, is the exhalant aperture to the gill-chamber; while the water, after bathing the gills, escapes behind through the aperture which usually serves for its entrance.

The Crab *Atelecyclus* is remarkable as a connecting link between the Portunid type and *Corystes*. Its antennæ are short, but constitute together a funnel for the entrance of water when the Crab lies buried in the surface layer of sand. If disturbed, however, the Crab burrows more deeply into the sand to a depth of several inches, where its antennæ are useless for this purpose. Under these circumstances the Crab is entirely hidden from observation, but by sinking a glass tube down to various parts of the body in succession, and watching the course of coloured water introduced through the tube, it was found that the crab folds its Claws beneath the margin of the carapace, after the manner of the Portunids, and uses also its other pairs of legs, which are provided with dense rows of bristles, to enclose a reservoir of water beneath its body. This reservoir supplies the gill-chambers with water

through the posterior aperture, and is itself supplied with innumerable streams which percolate from the surrounding sand through the channel between chelipeds and carapace, as well as through the filters formed by the interlocking rows of hairs on the legs.

By these and other instances which were copiously illustrated with the lantern, Mr. Garstang showed that the diversity of form in this group of animals is explicable as a series of special adaptations to different modes of life, and urged the importance of a comparative study of the habits, as well as of the structure, of each group of animals in which, as naturalists, they were severally interested.

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[The observations on the habits of *Atelecyclus* recorded above have not hitherto been published.—*W. G.*]

Photo by E. W. Priest.

NEOLITHIC IMPLEMENTS, THETFORD DISTRICT.

III.

REMAINS OF THE NEOLITHIC AGE IN THETFORD DISTRICT.

By W. G. Clarke.

Read 31st January, 1905.

In the ten years that have elapsed since I read a paper to the members of this Society on the subject of Prehistoric Man in Thetford District, my own collection of Neolithic flint implements has been largely increased, and I have examined many hundreds of other specimens found in the district, and tested the value of certain theories as to the local distribution of remains of the Neolithic Age. With but few exceptions these implements are found on the surface of existing heaths and "brecks," or of cultivated fields which were heath-land until the Enclosure Acts of about a century ago. The Neolithic land-surface appears to be about eighteen inches or two feet below the present, and on the primeval heath the only possibility of getting the implements results from the labours of rabbits and moles. On the "brecks," however, which were in most instances broken up towards the end of the 18th century and ceased to be cultivated when the price of corn made it unprofitable, the plough has transposed the ancient and modern land-surfaces, bringing to light large numbers of chipped flints, including a fairly large proportion of finished implements. There are, however, exceptions to this. On Rushford Heath, for example, the newly ploughed "brecks" yield no implements whatever, in spite of the fact that the abundance of stones makes the whole area appear, from a distance, as though it had been white-washed. Nearer the river, and not many feet above

it, on virgin heath-land, are two sandy hillocks, roughly rectangular in shape. Rabbits have honey-combed the outer slopes and thrown out an abundance of flints, almost every one being chipped. Among the flakes are fragments of rough pottery, liberally besprinkled with grains of quartzite, and seeming to evidence a stage of culture early in the Neolithic Age. These elevated areas may possibly have been the sites of settlements; the outer slope indicating the course of a ditch such as has been dug elsewhere under similar conditions.

Ploughing seems to have had more to do with the possibility of finding implements than has the height of the heath-land above sea-level. Some of the most prolific patches are only about 30 feet above, this being particularly evidenced on Thetford and Santon Warrens, Rushford Heath, and at the foot of Bromehill. Implements at this level are numerous enough to show that the height to which the waters of the adjoining river rose in Neolithic times could not be more than 10 or 15 feet above their present levels. The tops of the ridges were apparently avoided by Neolithic man, who preferred the slopes, those facing north and east yielding quite as many implements as those facing south and west. Among the reasons for choosing certain sites for settlements, sandy soil and the proximity of water were seemingly prominent, although it should not be forgotten that in all probability some of the valleys which are now dry contained water-courses when Neolithic hunters roamed the district. Implements are found in more or less abundance on both sides of the Little Ouse between Brandon and Thetford; but above the latter town the settlements are more sparsely distributed, many localities which to us appear eminently suitable yielding few or no implements. It seems almost useless to search for implements on heaths remote from the present rivers, or valleys connected with them. For this reason the large area variously known as Roudham, Bridgham, Brettenham, Kilverstone, and Croxton Heaths furnishes no traces of occupation by Neolithic man. On the north-east side of Fowlmere, however, on a piece of elevated land which

no very great rising of the waters would convert into an island, there appears to have been a settlement, and some beautiful scrapers have been found. Both north-west and north-east of Langmere the "brecks" yield a large quantity of chipped flints, some of good workmanship, with rough pottery. Several similar instances could be given.

Though on some of the heaths in the neighbourhood there are depressions which may have been pit-dwellings of prehistoric man, yet no exploration has ever been made. On Santon Downham Heath, in the spring of 1896, a sheep fell into a pit, domeshaped and circular, excavated out of the sand. The sides showed distinct traces of artificial working, and its diameter at the base was supposed to be 12 or 16 feet, but so much sand fell in that accuracy is impossible. On the same heath are numerous similar depressions. About 2 feet from the surface on Barnham Cross Common I found two heaps of fire-marked flints, probably "pot-boilers," and between them a layer about 2 inches thick containing charcoal, burnt bones and some small pebbles. About equi-distant from the piles of stones were two lumps of clay, one grey and the other red, the latter rarely found in the neighbourhood. About 1868 numbers of bones, urns, and burnt flints were found on Thetford Abbey Heath with flint, bronze, and iron implements. Remains of British settlements were also found a few years later on the field where the gasworks now stand, and on another adjoining Green Lane and Melford Common. Both are on the course of the Icknield Way. Probably most of the settlements in the district were of the character described by the Abbé Gaillard as *stations a ciel ouvertes*, that is, temporary above-ground residences of boughs, sods of turf, and the like. At this day the sites of such settlements are only to be found by the quantities of pottery and implements on the surface.

Among the factors which undoubtedly influenced Neolithic man in choosing sites for settlements, the nearness of flint, and the easiness of working it, must have occupied an important place. Even in the comparatively small area under notice there are certain local peculiarities which are instructive.

Grimes' Graves were probably one of the largest Neolithic flint quarries in England. The flint is black, yet all the implements found on the surface in the immediate vicinity are weathered white or grey, resembling those from the South Downs and from Ringland district, and quite distinct from all other implements found in the neighbourhood. Not only are these implements grey or white, but by far the greater proportion of those found in the district are shades of grey, blue, or yellow. For statistical purposes I selected those implements which appear to be perfect in form in my collection from Thetford district. Of these there are 593, and only 54 can be described as black, and very few indeed are of that perfect black which is characteristic of excavated flint from the immediate neighbourhood. Various shades of grey (including a large number of implements which may quite conceivably originally have been black) numbered 287 ; various shades of yellow, 130 ; various shades of blue, 87 ; and miscellaneous colours, 35. Yet strata of grey, yellow, or blue flint do not occur in the neighbourhood. Either the implements are made of isolated pebbles, or the colour of excavated flint from the chalk has been altered by atmospheric changes. That a certain proportion are made from pebbles is probable, for out of 593, 279 have still some portion of the original crust remaining. Another possibility is that members of the Neolithic tribe which worked Grimes' Graves, did not themselves value the black flint very highly, and exchanged it for flint of other colours from other districts. Against the theory of barter must be placed the undoubted fact that near the flint workings at Grimes' Graves the implements are as a general rule larger in size than is the case elsewhere in the district. Generally speaking, also, there is a tendency for implements to get smaller in proportion as one gets further away from Grimes' Graves, those on Thetford Warren and Thetford Abbey Heath being almost invariably small. Exceptions, however, occur not infrequently. Then, again, the knappers find by experience that the more delicate chipping can only be done when flint is newly quarried. As to the delicacy of the workmanship of local implements

there can be no question, and this would seem to imply that the flint from which they are made was dug in the vicinity. Where quarried flint was not obtainable, and flint pebbles from the boulder clay and the margins of the streams had to be utilised, the chipping is far inferior. This is noticeable in many districts of Norfolk and Suffolk. The possibility most in harmony with the facts is that the weathering of several thousand years may have so altered the appearance of the flint that the present blue or yellow semi-transparent implements may originally have been black and opaque. Evidence in support of this is furnished by the rechipped implements which number 23. Not included among these is a large implement, presumably an axe, which I found on Peddar's Way at Fring. On this the early chipping seems, undoubtedly, to be Paleolithic, and the later Neolithic. On those from Thetford district all the chipping is certainly Neolithic. These implements were probably worked early in the Neolithic period, lost or discarded, and then weathered by very many centuries of exposure, with the result that a thin coating, different in colour to the body of the flint was formed on the surface. Neolithic man subsequently found them again and partially rechipped them. Since they were rechipped, in most cases there has not been the slightest weathering, the obvious inference being that the lapse of time between their first and second chippings must have been immeasurably greater than that between their second chipping and the present time. This is quite possible if we accept the duration of the Neolithic Age as approximately from 20.000 B.C. to 2000 B.C.

Where such perfection could be obtained by chipping, polished implements are rare. In 1830 two polished axes were found at Barnham, and preserved on account of their curious shape; a polished adze is figured in Hunt's 'Ancient Capital of East Anglia,' while in Evans' 'Ancient Stone Implements of Great Britain,' fig. 37 is of an axe ground at the edge only, and found at Thetford, and fig. 43 represents a Santon Downham axe, the sides of which were slightly rounded by grinding. Mr. E. M. Beloe (King's Lynn) has a polished axe from Thetford, and two from Thetford Warren,

partially polished, are possessed by a Nottingham collector. Mr. F. Rix (Thetford) has a large polished knife from Snarehill; Mr. F. Russell (Thetford) an ashleaf arrowhead from the Abbey Heath, of which the more obtrusive angles have been rubbed off; and Mr. W. A. Dutt (Lowestoft) has the cutting half of a white axe, partly polished, from Weeting; a blue flint knife with one side of the cutting edge ground and the other chipped, from Santon Downham; and a fragment of a circular knife with both sides of the edge ground from the same place. Mr. P. R. Clarke (Norwich) has a rubbed knife, a rubbed axe of white flint from Snarehill, and an awl from Santon which had been rubbed on three surfaces, including both sides of the projecting point which forms the awl proper. In addition, the edge of this point has been most minutely chipped. In every case—except the Barnham axes—these rubbed implements are of flint, but in Grimes' Graves a ground axe-head of diorite was discovered, of a type usually found in Yorkshire. Specimens in my own collection are a white flint discoidal implement from Santon, rubbed on one edge—perhaps the beginning of a knife; a polished axe from Navarino, Thetford; a rubbed fabricator from Barnham Common; a triangular graver from Thetford Warren (fig. 5); a delicately chipped single-edged knife on which the rubbing extends from the central ridge to the side; and a piece of polished ivory (fig. 6) found near Thetford Waterworks, and considered by Mr. C. H. Read of the British Museum to have probably been used with a thong as a weapon of offence.

In practically all cases the bulk of the chipping on an implement is on the side opposite to the bulb of percussion. On a certain proportion the top of the bulb has been removed by a slight chip. This has been done on 174 specimens out of 593. With present day flint-knappers the fractured bulb is the exception, but a practised knapper can fracture the bulb intentionally nine times out of ten by the peculiar method of striking off the flake. The sole benefit of this operation would seem to be in affording a better grip than the rounded bulb would render possible.

The following table gives various details concerning 593 implements all found within a few miles of Thetford.

	Number of Specimens.	With Chipped Bulb.	With Part of Crust on.	Rechipped.	Black.	Shades of Blue.	Shades of Grey.	Shades of Yellow.	Miscellaneous Shades.
Arrowheads	7	—	—	1	—	—	3	3	1
Awls	10	4	5	—	2	2	3	3	—
Axes	15	—	5	1	—	1	14	—	—
Borers	19	8	11	—	4	2	7	3	3
Chisels	12	4	9	—	3	2	7	—	—
Fabricators	45	21	11	1	3	4	29	6	3
Gravers	42	13	18	1	4	5	17	13	3
Hollow Scrapers	50	21	29	3	4	4	29	9	4
Knives	122	35	50	6	9	14	53	41	5
Saws	5	—	1	—	—	—	5	—	—
Scrapers	213	65	115	9	24	46	83	49	11
Miscellaneous	53	3	25	1	1	7	37	3	5
Totals	593	174	279	23	54	87	287	130	35

Writing of flint implements in 'Mosses from an Old Manse,' Nathaniel Hawthorne says: "Their great charm consists in their rudeness and in the individuality of each article, so different from the productions of civilised machinery, which shapes everything on one pattern." This individuality of the combined designer and maker is certainly one of the greatest attractions to the archaeologist, and even in well-defined types numerous variations from the normal may usually be found. Those hereafter mentioned are, therefore, only the most uncommon examples of the handiwork of Neolithic man added to my collection of implements from Thetford district during the past ten years.

Arrowheads are decidedly uncommon. To some extent this may be due to the fact that for over thirty years the district has been fairly well worked, and these are implements that appeal to every casual searcher. On the other hand, as Professor Windle has pointed out: "In some districts many varieties of implements may be found; in others the range of examples is much more limited." The barbed arrowheads from the neighbourhood seem on the whole to

be smaller than those from other parts of England, a peculiarity for which it is difficult to account, although it is safe to assert that scarcity of flint was not the reason. (In parenthesis it may be stated that no genuine "pygmy" implements have yet been found in Norfolk, although those from Lakenheath are identical in form with the well-known types from Scunthorpe, Lincolnshire, and the Vindhya Hills, India). Among the chief additions to the arrow heads described in a previous paper is one of ash-leaf shape (fig. 1) from Thetford Abbey Heath, formed from a very thin semi-transparent yellow flake with chipping of extreme beauty. Its length is just over $1\frac{1}{2}$ inches, while the widest part—exactly 1 inch from the point—is $\frac{3}{8}$ of an inch across, evidencing a perfectly balanced implement. A large hollow-based javelin head of dark grey flint (fig. 3), found on Thetford Warren, is also an unusual specimen for the district. It is just two inches in length, and $1\frac{1}{4}$ across the base. Another implement (fig. 2), as to the classification of which there is some doubt, is either an unusual form of triangular knife, or a single-barbed lance-head, somewhat resembling an Irish specimen figured in the British Museum Guide. Of opaque yellow flint, it is $1\frac{3}{4}$ inches in length and $\frac{11}{12}$ of an inch in width, and was found in surface soil in a pit close by the Old Euston Road at Snarehill.

A noticeable fact regarding the awls is that in every case the point is on the left side of the flake, apparently indicating use by a right-handed man. Points of the borers are usually in the centre, and the other part of the implement is as a rule almost devoid of secondary chipping. Considering how plentiful flint is, the comparative rarity of axes is somewhat difficult to understand. Partly, no doubt, it is due to their size attracting the notice of the searcher, and partly to their weight, which in sandy soil causes them to sink when other implements are brought to the surface by ploughing. Those that I have found are for the most part small. Three fine specimens from Bromehill are each $2\frac{1}{2}$ inches long, two are just over an inch in width (one is shown in fig. 9), while the other is an inch and a half. Another Bromehill axe is

3½ inches long, and just over 2 inches wide. This was chipped in the early Neolithic age, then again worked in such comparatively recent times that the later chipping looks quite modern. With these may be compared a Paleolithic axe found a few years ago during excavations at Snarehill. It is 10 inches long, weighs 2 lbs. 10 ozs., and is 9 inches in girth. Most interesting of the 45 fabricators is a rechipped specimen (fig. 4) of dark-grey flint, while on the top are some characteristic flaking ridges, which have with the base weathered a light blue colour. The implement was subsequently rechipped, and the later chipping, though much battered, shows no signs of weathering. This specimen is from Thetford Warren. Another is roughly triangular in shape, with an indented base, $2\frac{5}{8}$ inches long and $2\frac{1}{2}$ inches broad, and was found at Santon. In every graver but four, that is in 38, the working edge is on the left-hand side of the implement, in two cases on the right-hand side, and two implements have two working edges, being apparently intended for ambidextrous users. A large graver found at Santon has the point to the right. The grey crust has been allowed to remain on top, but the edge is very well chipped. The implement is roughly triangular, 3½ inches long and just under 3 inches broad. Many hollow scrapers are of very beautiful workmanship. Thirty-two have the concave chipping on the side of the flake, 13 on the end, two have double hollows at the end of the flake, two double hollows on the same side of the flake, and one large hollows on opposite sides of the implement.

Knives are among the commonest forms of implement, and some of the finer specimens are among the most perfectly chipped. Of 122 specimens, 20 may be classified as triangular, 32 flake-knives, 4 oval, 26 single-edged, 28 double-edged, and 12 miscellaneous. Triangular knives seem to be uncommon in most other districts, and were apparently a speciality of local knappers. One of this variety has also a hollow base. In several instances quite a large handle has been formed by the original crust, the cutting surface of chipped flint being very small by comparison. A remarkable specimen

(fig. 8) is not only leaf-shaped, but also has a stalk, the leaf--shaped part being $2\frac{1}{4}$ inches long and an inch wide, while the stalk is just over half an inch in length and a quarter of an inch in width. Stranger still is a knife (fig. 10) in which a curious natural formation has been cleverly utilised to form a handle, the result being an implement of most uncommon appearance. A large curved flake-knife from a stone-heap at Snarehill is just under $6\frac{1}{2}$ inches in length and slightly over $2\frac{1}{2}$ inches in width at the widest part. The finest saw from the district has already been described and figured in the Transactions. I have found 5 others; 1 a flake with a portion of the outer crust adhering for a handle, 2 pointed flakes with roughly serrated edges, and 2 with only a portion of one edge toothed.

Scrapers are by far the most common implements in the district. Of 213 specimens only one is pear-shaped (fig. 7). This was found at Santon; one exactly like it was found at Santon Downham by Mr. W. A. Dutt. The under surface is quite flat, but the rounded upper surface is covered with most delicate chipping. It is $1\frac{3}{4}$ inches both in length and breadth. Other varieties are 2 knife-scrapers, 4 circular, 4 oval, 41 roughly square-ended, 42 duckbill (sometimes called "finger" scrapers), and 118 worked to a quadrant or more of a circle. The knife-scrapers are chipped on the back as well as the surface, so as to form a sharp cutting edge, that on the larger specimen being over 2 inches in length. Genuine circular and oval scrapers, that is, chipped equally all the way round and without a bulb of percussion so as to form a base, are very rare, although those that do occur are of fine workmanship. Two of the oval scrapers are flat-surfaced, with chipping only on the edges; two are chipped all over, the larger being 3 inches by $2\frac{1}{2}$. So far as my own collection evidences, more of the duckbill scrapers have a portion of crust adhering than has any other variety. One peculiar scraper seems originally to have been oval in form, 4 inches in length and a little over $2\frac{1}{2}$ in width. It broke in halves, was rechipped at the base, and thus left of unusual shape. One of the top surfaces has also been rubbed. A

scraper in Mr. J. W. Clarke's collection is partly chipped on the edge of the upper surface, the half circle being completed by chipping on the edge of the under surface.

Among the miscellaneous implements, some are discoidal, perhaps used as throwing stones. Others are square ended, one 3 inches broad and 4 inches long having been found near Grimes' Graves. Almost unique is a large implement found at Weeting and weighing 1 lb. 14 ozs. One edge has been worked so as apparently to form a large knife, while the other side, 2 inches in width, has been considerably battered on the outer edges, seeming to indicate that it was fixed with the broad edge uppermost and used as an anvil. It is 8¾ inches in length, and 3½ wide at the widest part.

IV.

DISTRIBUTION OF *SONCHUS PALUSTRIS*, L., AND *ATRIPLEX PEDUNCULATA*, L., IN ENGLAND.

By Arthur Bennett, F.L.S.

Read 31*st January*, 1905.

Two more very local and rare species that are among our decreasing plants.

No doubt before 1800 the *Sonchus* was to be found in many counties. In Lincolnshire, Arthur Young,* when staying with Sir Joseph Banks at Revesby Abbey in 1799, saw it in the East Fen. It is still to be found in Kent, possibly Essex, E. Norfolk and Suffolk. It seems to be quite extinct in Cambridgeshire, Middlesex, Huntingdon, Lincoln, and W. Norfolk. The large marsh form of *S. arvensis*, L., is at times

* Author of "A General View of the Agriculture of Lincoln," 1799.

mistaken for it, some of the Rev. Kirby Trimmer's localities being only the latter as "Langley"! It is a fine species, often growing among beds of reeds to the height of 8 feet. Brought from Plumstead Marshes, W. Kent, in 1874, to my garden, it has often been 9 feet high in damp summers. It sows itself abundantly, even in the crannies of some rockwork close by. It flowers the third year after sowing, and is then about 3 feet high. When first breaking through the ground the plants have protecting scales of a beautiful pink colour, which when about an inch high become suffused with pale green.

The English Botany figure t. 935, October 1, 1801, was drawn from specimens gathered by Mr. Groult, "7 feet 3 inches high." July 23, 1801, "near the Thames side between Greenwich and Woolwich."*

SONCHUS PALUSTRIS, Lin., Sp. Plant, ed. 1, 793, 1753.

MARSH SOW-THISTLE.

TALL MARSH SOW-THISTLE. *Petiver, Herbarii.* Brit. t. 14, fig. 7, 1713.

GREAT TREE SOW-THISTLE. Gray. Nat. Arrang. Brit. Plants, 418, 1821.

First Record. "*Sonchus tricubitalis folio cuspidata.* In the meadows betwixt Woolwich and Greenwich, by the banks of the Thames." Merrett. Pinax. Rer. Nat. Brit. 115, 1666.†

Distribution :—

Widely spread in Europe but nowhere common. Denmark, Sweden, Scania and Blekinge, France, Germany, Holland, Belgium, Spain, rare, Switzerland ? Corsica, N. Italy, Austro-Hungary, Poland, Russia, in 12 Governments; Caucasus. Indicated doubtfully in Russian Asia.

In England :—

Co. 15. KENT E. (1666).

Near Aylesford. Marshall. Fl. Kent, 222, 1899.

Co. 16. KENT W. (1801).

* F. N. A. Garry. Notes on the Drawings for Eng. Botany. Supp. to 'Journal of Botany,' 111, 1903.

† W. A. Clarke. 'First Records of British Plants,' 86, 1900.

Deptford, Kippist, 1829. Plumstead, J. Irvine, 1860; Syme, 1861; A. Bennett, 1877; A. E. Bennett, 1881. Woolwich, Sowerby! Halling, Irvine, Lon. Fl., 1838. Snodland, Webb, 1875! Wouldham, Henslow, 1825! Burnham, Webb, 1875! Woolwich, 1889, Col. Wolley-Dod. Near Maidstone, Lamb in 'Science Gossip,' 1889. Backwaters of the Medway, near Aylesford; B. King, J. of Botany, 346, 1881.

18. Essex S. 1695.

Marshes near W. Ham, seen about 20 years ago. Phyt. 1862, 337.

Marshes by the Thames below Plaistow, sp. in herb. Winch! Poplar *l.c.*!

Near Rainham Creek. E. Foster, in Gibson's Fl. of Essex, 1862, 192.

N. Woolwich, 9, 8, 1867. J. W. White and D. Hanbury in Brit. Museum Herb!

21. Middlesex. 1696, last 1805

In the Isle of Dogs; Buddle MSS.

In the Isle of Dogs, E. Foster, Junr., Bot. Guide, 1805, 410.

Dr. Syme could not find it there in 1852. Phyt. iv. 860, 1855.

23. Oxford.

Druce in 'Journal of Botany,' 1893, 183. Account of finding it in Report Bot. Exchange Club for 1894, 457

25. Suffolk E. (1724).

Lothingland, Sherard in Dill, Ray, 1724. Ditches under Burgh Castle, L. Wigg, Bot. Guide, 1805, 561; Priest sp., 17, 7, 1836. Lady Blake, circa 1840-50; sought in vain in 1877.

Ditches north of Oulton Dyke, Herb. Skepper.* Between Bungay and Shipmeadow, Holmes.* Riverside at Beccles and Worlingham, Rev. G. Crabbe, Bot. Guide, 1805.

Belton. Phyt. 1862. 368; St. Olaves *l.c.* 370; near Mutford Bridge, Skepper.* Palgrave. Collins in Hind's Fl. Suffolk. Found in two places in this county by Mr W. A. Dutt in 1904.

* Henslow and Skepper. Fl. Suff. 50. 1860.

Burnt Fen, J. Crowe, M.S. in Hudson's Flora Anglica in Linnean Society's Library.

This Fen is partly in Suffolk and partly in Cambridgeshire, but the major portion is in the latter county.

27. NORFOLK E. 1830.

Banks of the Waveney between Beccles and Yarmouth.

Woodward in Withering. Arr. Brit. Pl. ed. 7, iii., 1830, 884.

Hardley, Strumpshaw, Acle, Cantley. K. Trimmer, Fl. Norf.. 1866. 86.

Reedham. Rev. Leathes in herb. Borrer at Kew!

W. & E. Somerton, 1873; Rollesby, 1876; K. Trimmer Supp. Fl. Norf., 1884. 27. Hickling, Rev. M. C. H. Bird to Mr. Nicholson.

In the marshes opposite Burgh Castle on the Norfolk side of the Waveney, T. Butler, Mrs. Russell, and C. C. Babington. Phytl, 1858, 279, 357.

Burgh St. Peter. W. A. Dutt to Mr. Geldart, 28, 7, 1902. "Found by Mrs. Baker of Oulton Broad in 1898 and 1899, 8 feet high." Mr. W. A. Dutt in litt.

Sought between Berney Arms and Yarmouth on the north side of Breydon, Aug., 1904, but only *S. arvensis, L.* sub-var *elatior* Coss. and Germ. found. Mr. Nicholson.

28. NORFOLK W.

Meadows at Gaywood. Crowe, *l.c.*

Titchwell and Brancaster. K. Trimmer, Fl., *l.c.*

29. CAMBRIDGE

Near Streatham Ferry. S. Lyons Fas. pl. pl. Cantab, 1763, 47. "Not seen there for many years." Relhan in Bot. Guide, 1805. Bottisham Fen, 1839. S. Hailstone in herb. York Phil. Society.

Bottisham Fen, opposite the "Knave of Clubs" Ale house in 1843. S. Hailstone, *l.c.* Bottisham Fen was drained before 1848.* Mr. W. Marshall of Ely appears to have gathered it in the county about 1853. See Phyt., 1857, 250.

31. HUNTS.

* G. S. Gibson in Phyt. iii, 309, 1848.

Berkley MS. in Watson's Topl. Botany, ed. 1, 218, 1873. Probably somewhere near Holme Lode by Whittlesea Mere.

53. Lincoln S. ?

By the kindness of Miss M. Knowles of the Dublin Museum, I have seen a specimen with the following label :—

"Ex. herb. Lord de Tabley.
Sonchus palustris.
Fens, Lincolnshire. A. Bloxam."

The Rev. A. Bloxam (1801-1878) was a good botanist, and sent a list of plants from S. Lincoln to Mr. Watson. From various sources I believe his visit was paid somewhere between 1855-1860, or 1852-1873.

In South Lincoln Crowland Wash, or Elloe hundred in S. Holland would be likely places. Crowland Wash up to 1845 must have been very wet, as the Black Tern was said to nest there just before.*

54. Lincoln N.

East Fen. A Young, *l.c.*

There is no specimen in Sir J. Bank's herb. at the Brit. Museum, and no other N. Lincoln sp. is known.†

Gough in his ed. of Camden's Brittania ii. 1789, says of the E. Fen: "It is a vast tract of morass, intermixed with numbers of lakes, from half-a-mile to two, or three miles in circuit, communicating with each other by narrow reedy straits. They are very shallow, none above four or five feet deep, but abound with Pike, Perch, Ruffs, Bream, Tench, Dace, Eels, etc."‡ Dugdale gives a list (60 names) and a map of these lakes.‖

Doubtful Counties.

17. Surrey.

J. S. Mill. "Croydon" Hooker, Brit. Flora, 1835, 346. Mill knew the plant, and it is just possible it may have

* Lubbock. 'Fauna of Norfolk,' ed. 2, 168, 1879.
† "Woodruffe—Peacock" in 'Naturalist,' 100, 1895.
‡ 'Fenland, Past and Present,' 150, 1878.
‖ 'History of Embarking.'

occurred on the swampy common, enclosed in 1798, and long since built over.

3. Devon S. Totnes Flora.

Hants error for Hunts in Eng. Botany ed. 3.

20. Herts. Fl. Hertfordiensis.

39. Stafford. Nat. Hist. of Staffordshire.

40. Salop. Fl. of Shropshire.

55. Leicester. Rarer plants of Leicestershire.

56. Nottingham. Nottinghamshire Flora.

69. Westmorland. Martineau Guide

75. Ayr. Ayrshire Botany,

82. Edinburgh. Flora Edinensis.

The other species, *Atriplex pedunculata* is one of those curious plants that can never be depended on. I have known it to be searched for in Kent, seven years in succession, and not found; the next year it will be abundant. I have seen it myself in that county in hundreds of specimens, and two years after had great difficulty in finding two or three small examples, although going over the same ground. Being an annual it can hardly be from the same cause as the Orchids, that appear and disappear in so puzzling a way. It fruits late. On September 13th I could find no ripe fruits.

Between 1834 and 1848 it was tolerably common around Yarmouth, both in Norfolk and Suffolk, but has now become very rare. I have sought it unsuccessfully around Breydon, and do not know of its having been gathered of late years. The middle of September is the best time to search for it, as its peculiar fruits at once call attention to it at that time.

I shall be glad to hear of its recent occurrence in E. Norfolk.

Atriplex pedunculata, L., Cent. pl. i. 33, 1755.

Halimus pedunculatus. Wallr. Sched. Crit. 117, 1822.

Obione pedunculata. Moq. Tand. Chenopod, Enum, 75, 1840.

Heart Sea Purslane. Petiver Herb. Brit. t. 7, fig. 8, 1713.

Pedunculated Sea Orache. Smith Fl. Brit. iii., 1095, 1804.

Footstalked Orache. Gray, Nat. Ar. Brit. pl., 282, 1821.

Stalked-fruited Sea Orache. Syme, Eng. Bot. viii., 37, 1868.

A. Gray, *l.c.*, has a *B. humilis ;* this is merely when it has grown in drier places, or the main stem become broken.

First Record.

"A *Marina semine lato nondum descripto.* John. Merc. Bot. ii., 16, 1641. Near Harlecham." This may be a first record, but there is nothing known of its having grown in Merioneth that I can discover. It is not given in either of the Botanical Guides, or Watson's Outlines. The real first record, with locality, I take to be Sherards in Ray's Syn., 1690. "In the south of Kent, near the ferry, in great plenty." Another early one is Plukenet in Gibson, 1695. "Prope Shirbeck vicinum miliare a Bostonian distantibus copiose provenit." The English Botany, fig. t. 232. Feb. 1, 1795, was drawn from specimens gathered by Mr. Lilly Wigg in "Salt Marshes near Yarmouth." The notes* do not give the county, but probably it was Suffolk.

Distribution :—

South of Sweden, Denmark, Germany N. and W., Holland, Flanders, France N. and W., Russia, Caucasus, Siberia, Turkestan.

In England :—

15. Kent E.

Between Sandwich and Pegwell Bay, sometimes abundant, at times very difficult to find, and then only 1 inch high ; abundant in 1877 and very fine. 1890 ! 1894 Miller, sp. 1900, Holmes sp.

Salt pans between Great and Little Stoner, Cowell, Fl. Guide to E. Kent, 75, 1839.

Pegwell Bay, Miss Harvey, *l.c.*; side of the river Stoner from about a mile and a half beyond Sandwich down to the sea at Shellness. Syme, Eng. Bot. 8, 37, 1868.

On black boggy ground on the right-hand of the sea-shore between Herne Bay and Whitstable. Rev. W. Wood in

* "Notes on the Drawings for Eng. Botany." Supp. to 'Journal of Botany,' 159. 1904.

Cowell, *l.c.* Marshes near Deal. Mrs. Benson in Flora of Kent.

16. KENT W.

Near Shorne Battery below Gravesend, Syme, *l.c.*

Salt marsh 2 miles below Gravesend, August, 1842. Mitten in 'Phytologist,' 1, 366, 1842.

25. SUFFOLK E.

Aldborough. Gissing in Phyt. 1, 324, 1856.

Shore of Breydon. Wigg in Bot. Guide, 568, 1805.

On banks by the highway side between Yarmouth and Gorleston, Sep. 3, 1764. Mr. Bryant. The banks are since destroyed, and Mr. B. could not find it in 1766. Dillenius in Herb., Oxf.

Breydon Water. Herb. Skepper, 30, 8, 1857. "Shown to me by Mr. D. Turner in a salt marsh on the Suffolk side of the river at Yarmouth, a little way from the bridge to the right of the road going to Gorleston. It grows there in very considerable abundance." Sir J. Bunbury MS. in Hind, Fl., Suff. 298, 1889. Specimen thence in Ipswich Museum.

Walberswick and Shingle Street, Holmes; Cobham Island. Sir J. Paget. N. H. of Yarmouth, 65, 1834. J. Priest, sp. 26, 8, 1842. This is now built over.

27. NORFOLK E.

In plenty in some of the salt marshes at Runham. Paget, *l.c.* Briant in herb. Brit. Museum, 1776!

Side of Breydon. Lilly Wigg in herb. Winch! Yarmouth, Rev. Bradley, 1780, Woodward; "In the salt marshes out of the North gates, 1786. J. Dickson, 1793, Herb. Foster, 1802.

28. NORFOLK W.

On the east bank of the Ouse below Lynn, 1788. Dr. Smith herb.

Holme, Sept. 13, 1800. Rev. Dr. Sutton in Diary. Trans. Norf. and Nor. Nat. Soc., vol. vii., p. 460, 1903 (T. Southwell).

Thornham and Holme-next-the-Sea. K. Trimmer, Fl. Norf. 124, 1866.

Hunstanton to Thornham. B. Bray, ex. W. A. Nicholson.

29. CAMBRIDGE.

Wisbeach by the river side a little way below the town, and in the salt marshes. Mr. Skrimshire in Bot. Guide, 66, 1805.

" Extinct," Babington. Fl. Camb., xxi., 1860.

53. Lincoln S.

On the roadside between Fossdyke and Cross-key Washes, in some years vastly abundant, in others very difficult to find. Sir. J. Banks in Bot. Guide, 392, 1805. Herb. Brit. Museum from Banks, 12 specimens on one sheet. As to the locality of Skrimshire's specimens, see 'Naturalist,' 136-7, 1897.

54. Lincoln N.

Near Skirbeck Churchyard, half-a-mile from Boston. Sir J. Banks, *l.c.*

On the coast between Mablethorpe and Gibraltar Point. Burgess' Paintings, 'Naturalist,' 184, 1896.

Has occurred on ballast heaps in Carmarthenshire and Durham.

Ireland.

Muddy marshes in Cushtrower Bay, near Ballinatrinch, Connemara. Wade, Cat. pl. rar. in com., Gallovidiae, Dublin Soc. Trans. 1, 2. 1801.

" Prof. Babington and other botanists have not succeeded in finding it in this locality." More and Moore. Cyb. Hib. ed. 1, 250, 1866.

V.

THE LIFE HISTORY OF THE CLADOCERA.

By Robert Gurney, B.A.

Read 28th February, 1905.

Cladocera, or Water-fleas, are to be found in almost every collection of fresh water, however small, even if it is not a permanent one. In fact, the foulest of farm ponds often contain a greater abundance of individuals than the clear weedy water of the Broads, though not such a great variety of species.

During a large part of the year all these individuals are of one sex—there are no males to be found, and all are alike capable of producing eggs and young. The eggs are not laid free in the water, but into a cavity between the body and the shell called the brood pouch. See fig. 1. Here they develop till they are hatched in a form resembling that of the parents. Successive broods are produced at intervals, in favourable circumstances, of two or three days. Each brood, in the case of *Daphnia pulex*, may consist of about 30 young, and broods of as many as 78 have been recorded. Multiplication is consequently very rapid. It has been calculated (Ramdohr 1805) that the offspring of a single *Daphnia pulex* in 60 days might amount to 1,291,370,075 ! In view of such prodigious fecundity it is not surprising that it takes but a few days to populate a previously untenanted pond.

It was long ago proved that such reproduction may continue for a long time without the intervention of the male sex, but the significance of the fact was not understood. Speculations on this point at the beginning of the Nineteenth Century were naturally affected by the state of knowledge possessed at the time as to the phenomena of reproduction. Nothing was then known of what is now called parthenogenesis, and it was natural to assume that the Cladocera, which were seen

to reproduce without the need of males were hermaphrodite, even though male organs could not definitely be seen. Schaeffer (1755), Ramdohr (1805), and Strauss (1819), for

Fig. 1. Scapholeberis aurita (S. Fischer).

example, supposed that they were capable of self fertilisation. Parthenogenesis as a mode of sexual reproduction was not fully proved to exist till 1845, when it was shown by Dzierzon that the Honey Bee produces eggs which develop either with or without fertilisation. Hitherto, when it had been shown that, as in the case of Aphis, egg-like bodies might give rise to young without fertilisation. it was assumed that these

bodies were not true eggs, but internal "buds" or "pseudova" comparable to the buds of Coelenterata. Von Siebold (1856)* was the first to prove that the reproduction of the Cladocera and certain other Crustacea was parthenogenetic, or by means of true eggs not requiring fertilisation, but even then his conclusions were disputed—for instance, by Leydig (1860).†

At certain times of the year, particularly in autumn, males appear also and sexual‡ reproduction occurs, generally together with parthenogenetic, but sometimes replacing it entirely. The fertilised eggs are quite different from the agamic eggs. Their yolk, instead of being in large, clear globules, is in the form of small dark coloured granules, giving the egg a very dark appearance and hiding the nucleus. They are also radically different in their origin, requiring the absorption of many more "nurse cells" than the summer eggs do. They are also protected by a rather thick shell. These fertilised, or "resting," eggs are laid in the usual way, but they do not develop at once, being destined to be shed with the moulted shell and, when laid in autumn, to rest during the winter and to hatch in the following spring. They will bear complete drying and freezing, and are actually the better for it. They may be kept for years in the dry state. In fact, much of our knowledge of exotic Cladocera has been acquired by hatching them from eggs contained in mud sent to Europe for the purpose. It is by their means that the species are preserved from extinction by frost and the drying up of water. It is only a few species that shed their eggs free in the water, and in these species, *e.g.*, *Sida crystallina*, probably the unprotected eggs would not bear so much as those of other species. In the majority of cases the eggs are protected by a specially modified part of the shell known as the Ephippium. In the Daphnidae, where

* 'Wahre Parthenogenesis bei Schmetterlingen und Bienen.' Leipzig, 1856, p. 138.

† 'Naturgeschichte der Daphniden.' Tübingen, 1860.

‡ I use the word "sexual" in opposition to "parthenogenetic" simply for convenience. Of course parthenogenetic reproduction is really sexual. "Amphigonic" and "Agamic" reproduction would be more correct.

ephippium-formation is most complete, the ephippium is a saddle-shaped area of thickened chitin which may or may not become darker than the rest of the shell, but which is

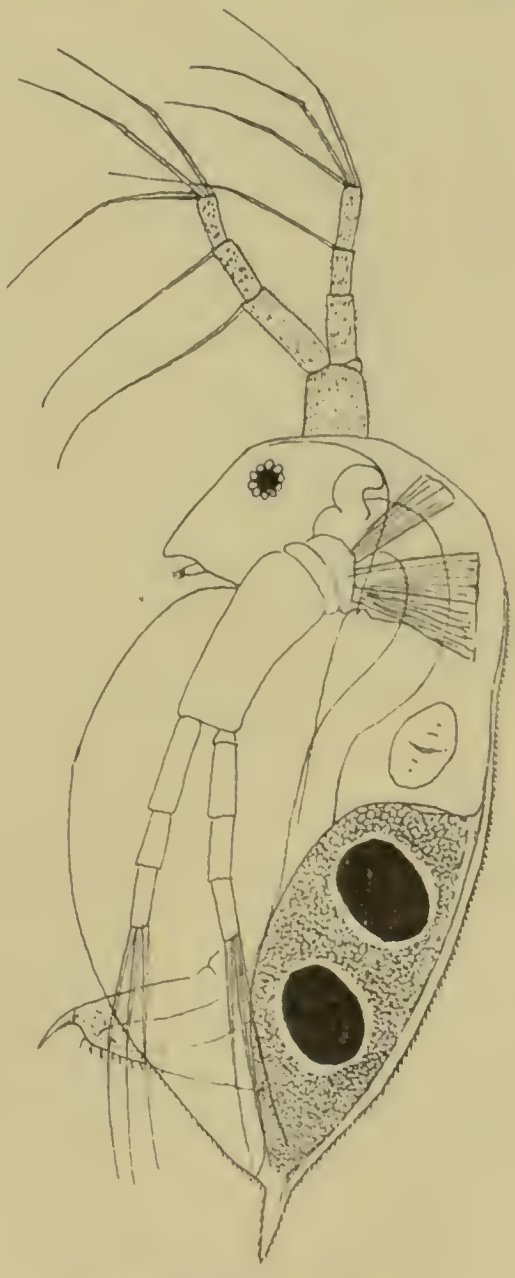


Fig. 2. Daphnia atkinsoni, Baird.
Ephippial female. × 37.

always marked off by its more pronounced and generally finer reticulation. See fig. 2. In some cases, *e.g.*,

Ceriodaphnia pulchella, it is covered with little elevations of the chitin.

The Sididae and Polyphemidae lay their resting eggs protected only by their thick shell. The Lynceidae have ephippia, but generally the part of the shell from which they are formed is only slightly modified. It becomes darker in colour and somewhat thickened, but that is all (fig. 3). *Alonopsis ambigua* is exceptional in having an ephippium which might easily be mistaken for that of a Daphnid.

In all cases in which an ephippium is formed provision must be made for casting it off with its contained eggs. This is effected by means of a "line of weakness" running round its edge. In the Daphnidae the chitin along this line is quite thin and unmarked by reticulations, but in the Lynceidae the line is marked by a series of elongated reticulations (fig. 4). The shell easily breaks along this line, and the ephippium is cast off, showing, in the Lynceidae, a jagged edge corresponding to the broken reticulations. The shell consists of two layers, of which the outer one only is thickened. The inner one, when the ephippium is cast off, wraps round the egg, while the edges of the outer one close together and prevent the evaporation of water from the cavity within.

Generally the ephippium floats upon the surface and is easily transported by birds or other agencies. Probably the sudden appearance of species in a locality in which they have not previously been found is due to the transportation of the resting eggs. In a pond at Herringfleet, kept continuously under observation, two rare species, *Daphnia atkinsoni* (fig. 2) and *Alonopsis ambigua* (the latter an addition to the British Fauna) appeared suddenly in this way and disappeared as suddenly—probably from the conditions proving unsuitable.

In the Daphnidae there are generally two eggs in the ephippium, but never more. In the Lynceidae there is only one except in the case of *Eurycercus lamellatus* which has several. The Sididae and Polyphemidae have several resting eggs.

Fig. 1. CAMPTOCERCUS HILLJEBORGII, Schödler.
a. Ephippial female. × 100.
b. Part of Postabdomen. × 200.

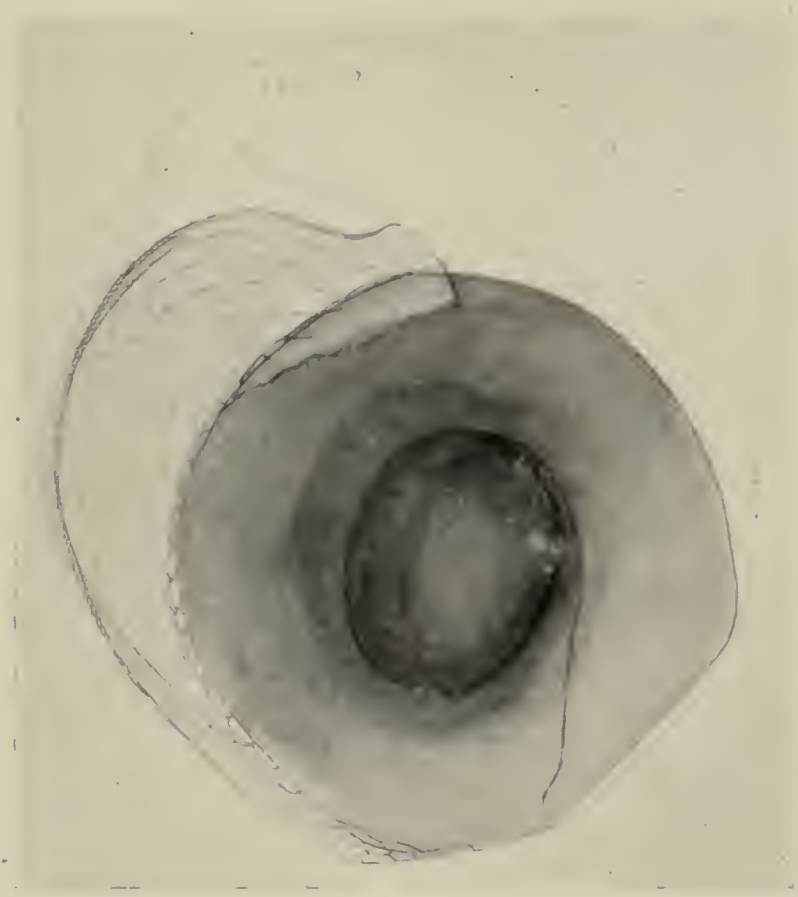


Fig. 4.

CHYDORUS GLOBOSUS. Baird.

Ephippium × 100.

The dotted line roughly completes the outline of the animal before moulting.

As I have said, sexual reproduction takes the place of agamic reproduction at certain seasons of the year. Generally speaking, this sexual phase occurs in the autumn, reaching its climax in October or November. Throughout the summer males and ephippial females of certain species can be found occasionally; in September a large number are sexual, while in October the majority of the commoner species are producing resting eggs. The summer forms begin to disappear in November, and sexual reproduction declines, either at the beginning or at the end of the month. By December very few species are sexual.

It must not be supposed that every individual produces resting eggs; in many species the majority remain parthenogenetic—particularly among the Lynceidae. It is only those species which are destined to die out in the winter which wholly or in large part change their mode of reproduction. Consequently, the abundance of males varies with the species. In some species, such as *Sida crystallina*, they are about equal in number to the females, and even exceed them at the end of the season, since the females appear to be rather more sensitive to cold. In other species, such as *Daphnia longispina*, they are very rare in comparison to the whole number of females, though probably they are in tolerably equal proportion to the ephippial females.

But besides the sexual period in autumn there is also another, less intense, in early summer. This first period is not very clearly marked, but it may be distinguished in the table and diagram No. 1. The first gives the whole list of species and the number of times each has been recorded as sexual during the two years. The other gives the total number of records expressed, in the form of a curve, as percentages of the total number of collections in each month. Since exceptional individuals of a species may be found sexual when the species as a whole has not really entered on a sexual phase, it is best to tabulate, not the number of species, but the whole number of records as indicating the intensity of the phase for all species together.

Looking at the diagram, a sharp rise may be seen in the curve

	January.		February.		March.		April.		May.		June.		July.		August.		September.		October.		November.	
SIDA crystallina					†		†		†	†	†	†	†		†		†	†	†11	†4	†3	†
DIAPHANOSOMA brachyurum							†		†		†	†	†		†5		†10	†2	†6	†1		
DAPHNIA magna		†		†	†	†		†			†6	†	†1		†1		†1	†	†2	†	†	†
,, atkinsoni											†1				†1			†	†		†1	†
,, pulex	†	†	†	†	†1	†	†2	†3	†4	†	†3	†1	†2		†2		†6	†	†8	†1	†7	†
,, longispina	†	†	†	†	†	†	†1	†	†4	†1	†6	†	†7		†2		†4	†	†1	†	†5	†
,, lacustris		†		†							†	†	†		†		†		†		†	
,, cucullata										†	†	†	†2		†1		†1	†1	†4	†		
SCAPHOLEBERIS aurita															†		†2	†2	†3			
,, mucronata							†		†	†	†	†	†2		†		†6	†	†5	†1		†
SIMOCEPHALUS exspinosus				†				†		†					†		†1	†	†	†	†1	
,, vetulus	†	†	†	†	†	†	†	†	†	†1	†	†	†		†1		†	†	†	†	†	†
CERIODAPHNIA reticulata			†		†		†	†	†	†	†1		†7		†		†4	†1	†11	†10	†5	†
,, megalops										†	†		†1		†		†	†2	†8	†1	†1	†
,, quadrangula		†1			†	†	†	†	†	†	†	†	†		†		†2	†	†4	†	†3	†
,, pulchella	†	†							†	†	†	†	†5		†		†3	†	†13	†6	†4	†
,, affinis											†1		†				†2		†1	†		
,, laticaudata									†		†1	†	†1		†		†1	†	†2	†1	†	
MOINA rectirostris															†1		†	†1			†	
BOSMINA longirostris	†	†	†	†	†	†	†	†	†	†1	†12	†5	†2		†		†2	†	†1	†	†	†
ILYOCRYPTUS sordidus					†		†		†	†	†	†	†		†		†	†	†	†	†	†
,, agilis		†			†		†			†	†	†	†		†		†	†	†	†		
,, acutifrons											†	†	†		†			†	†			
MACROTHRIX laticornis										†							†	†	†	†	†	
LATHONURA rectirostris	†	†	†	†	†	†	†		†		†		†		†		†		†	†	†	†
EURYCERCUS lamellatus	†	†	†	†	†	†	†	†	†	†	†	†	†		†		†	†	†	†	†	†
CAMPTOCERCUS rectirostris									†	†			†		†		†	†	†1	†	†1	†
,, lilljeborgii													†		†		†		†2	†2		
ACROPERUS harpae	†	†	†	†	†	†	†	†	†	†	†	†	†1		†1		†	†	†10	†2	†5	†
ALONOPSIS ambigua																		†1		†		
LYNCEUS quadrangularis	†	†	†		†		†	†	†	†	†1	†	†1		†		†	†	†	†	†	†
,, affinis	†	†	†	†	†	†	†	†	†	†	†	†	†		†		†	†	†1	†	†	†
,, tenuicaudis													†		†		†1	†1	†	†1		
,, costatus					†	†	†		†	†	†		†		†		†	†	†8	†4	†2	†
,, guttatus	†		†		†		†	†	†	†	†		†		†		†		†	†		†
,, rectangulus									†		†		†		†		†2	†	†4	†4	†	†
,, elegans																			†			
,, rostratus							†	†	†	†	†	†	†		†		†	†	†3	†1	†1	†
LEYDIGIA quadrangularis							†	†	†		†		†		†1		†		†1	†	†	†
,, acanthocercoides									†				†		†1		†					
GRAPTOLEBERIS testudinaria					†	†	†		†	†	†	†	†		†		†	†	†2	†	†2	†
ALONELLA excisa		†		†		†	†		†		†2		†		†1		†	†	†	†	†	†
,, exigua		†						†							†		†		†1	†	†	†
,, nana	†	†		†	†	†	†	†	†	†	†3	†	†				†	†	†	†	†	†
PERATACANTHA truncata					†		†		†		†	†	†		†		†	†	†5	†5	†3	†
PLEUROXUS laevis											†		†		†		†	†	†	†		
,, trigonellus	†		†		†	†	†		†	†	†	†	†		†		†	†	†	†1	†1	
,, aduncus	†			†			†		†	†	†	†	†		†		†	†	†	†	†	
,, uncinatus		†			†	†	†	†	†	†	†	†	†		†		†		†	†	†	
CHYDORUS globosus		†							†	†	†	†	†		†		†	†	†	†1	†	†
,, ovalis	†	†	†		†	†	†		†		†		†		†		†1	†	†	†		†
,, sphacricus	†	†	†	†	†	†	†2	†	†	†	†1	†	†		†		†	†	†	†	†	†
ANCHISTROPUS emarginatus																	†					
POLYPHEMUS pediculus					†		†	†	†	†	†	†	†2		†		†	†	†7	†2	†3	†
Total species	16	21	14	15	25	18	30	20	35	30	42	30	45		48		50	43	50	45	38	35
Total species sexual	–	1	–	–	1	–	3	1	2	3	12	2	13		12		16	8	27	18	17	1
Total sexual records		1	–	–	1	–	5	3	8	3	18	6	34		18		48	11	125	48	48	3

Table No. 1. Showing seasonal distribution of Cladocera in Norfolk during 1903 and 1904 (left hand c each pair, 1903; right hand, 1904). The cross indicates the occurrence of the species, and the figures the n sexual records for each species. The general lowness of these figures for 1904 is due to the smaller number of co

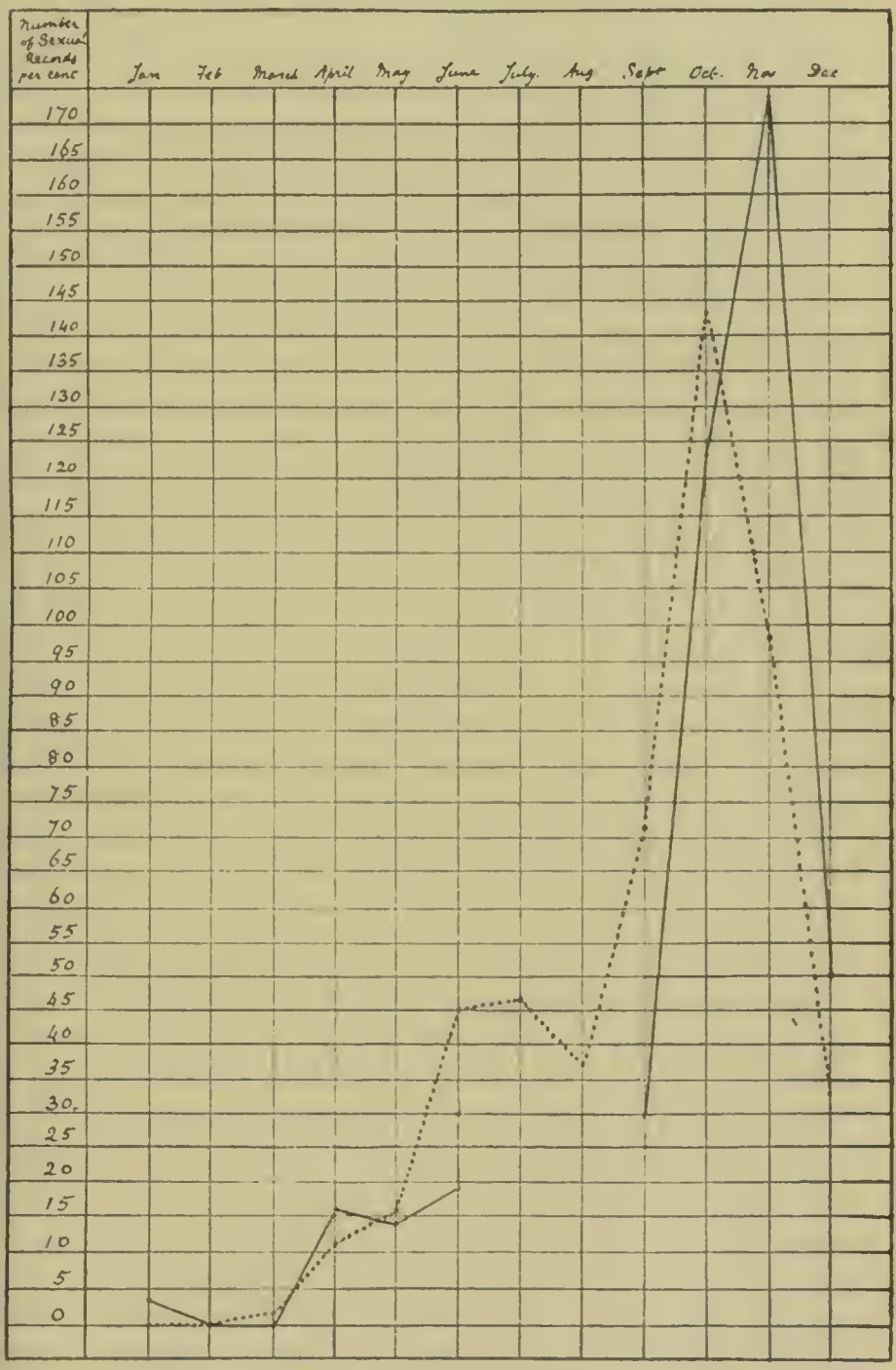


Diagram 1.—Showing total number of Sexual Records expressed as percentages of the total number of collections in each month of the years 1903 and 1904.
Dotted line 1903, unbroken line 1904.

for 1903 in June, followed by a fall in July and August, before the great rise showing the chief sexual period in October. There is a break in the records for July and August of 1904, but the records for June and September seem to indicate a similar course in July and August, though probably the maximum fell actually in July in that year and not in June.

Generally speaking, those species that are sexual in summer are also sexual in autumn, and these are called Polycyclic species, since they have more than one cycle in the year. That is to say, the individuals of the first, or spring cycle, lay resting eggs which hatch in the late summer and give rise to the individuals of the second, or autumn cycle. For example: *Ceriodaphnia pulchella.* Those that have but a single cycle in the year are called monocyclic, *e.g.*, *Sida crystallina.* Those that are always found parthenogenetic are acyclic. As Weismann* surmised, there are probably no acyclic *species*, but only acyclic colonies of cyclic species. The category into which any species falls varies and depends upon its surrounding conditions. In the Arctic regions agamic reproduction plays a relatively unimportant part, and the number of generations between the individuals hatched from the resting eggs and the sexual brood is generally few. In the true Arctic conditions all species, with a few exceptions, are Monocyclic, owing to the short space of time during which the water is free from ice (Ekman 1904†).

Now, inasmuch as the production of resting eggs is a measure for the protection of the species from adverse conditions, one would expect that where such adverse conditions do not constantly recur, parthenogenesis would be retained as being the most rapid mode of multiplication. Extremes of heat and cold and the drying up of water are the usual causes of destruction. As the Norfolk Broads do not dry up and are deep enough not to get over heated, it is only to be expected that the first cycle, which seems to be more pronounced in other countries, should here be rather indistinct. The species which are recorded as sexual in early summer are

* Zeits. Wiss. Zool., vol. xxxiii., 1883.

† Zool. Jahrb., Bd. xxi., 1904.

mainly those which live habitually or commonly in ponds or ditches exposed to the chance of drying up or to extremes of heat—for example *Daphnia pulex*. *Bosmina longirostris* is an apparent exception, but it is a species which appears to die out to some extent in summer. The genus Bosmina is one of probably Arctic origin, and it is possible that, like *Cyclops strenuus* and, to some extent, *Canthocamptus staphylinus*, it is not able to bear the high temperature of summer.

As a matter of fact, here in Norfolk, conditions seem to be exceptionally favourable all the year round. In Germany apparently many species die out completely in winter which here remain abundant—*e.g.*, *Daphnia longispina*. Apparently as a direct result of this I find many species to be either acyclic here, or very rarely to show sexual individuals. For example, I have never seen an ephippial female or a male of any species of Macrothricidae ; one of the commonest of the Lynceidae, *Eurycercus lamellatus* was never found sexual during 1903 and only a few times in 1904.

If, as I suppose, their whole economy is affected by their permanent or average surroundings, it becomes a question whether it may also be affected by their changing surroundings —by weather for instance.

The weather of 1903 differed considerably from that of 1904, and diagram No. 2 shows the mean temperature of each month of those years in the form of a curve. In table No. 2 I have selected certain of the species which are specially summer forms and of which the records are sufficiently full to be reliable. Table No. 1 gives the whole list of species for the two years for comparison. It will be seen that in 1903 nine of the summer forms appeared earlier than they did in 1904, that is to say, though in one or two cases they were first recorded in the same month in each year, still there were differences of ten days or so. Only one species, *Ceriodaphnia megalops*, appeared earlier in 1904 than in 1903.

It is probable that the resting eggs require a certain minimum of heat, different perhaps for different species, before they can develop, and that this minimum was reached

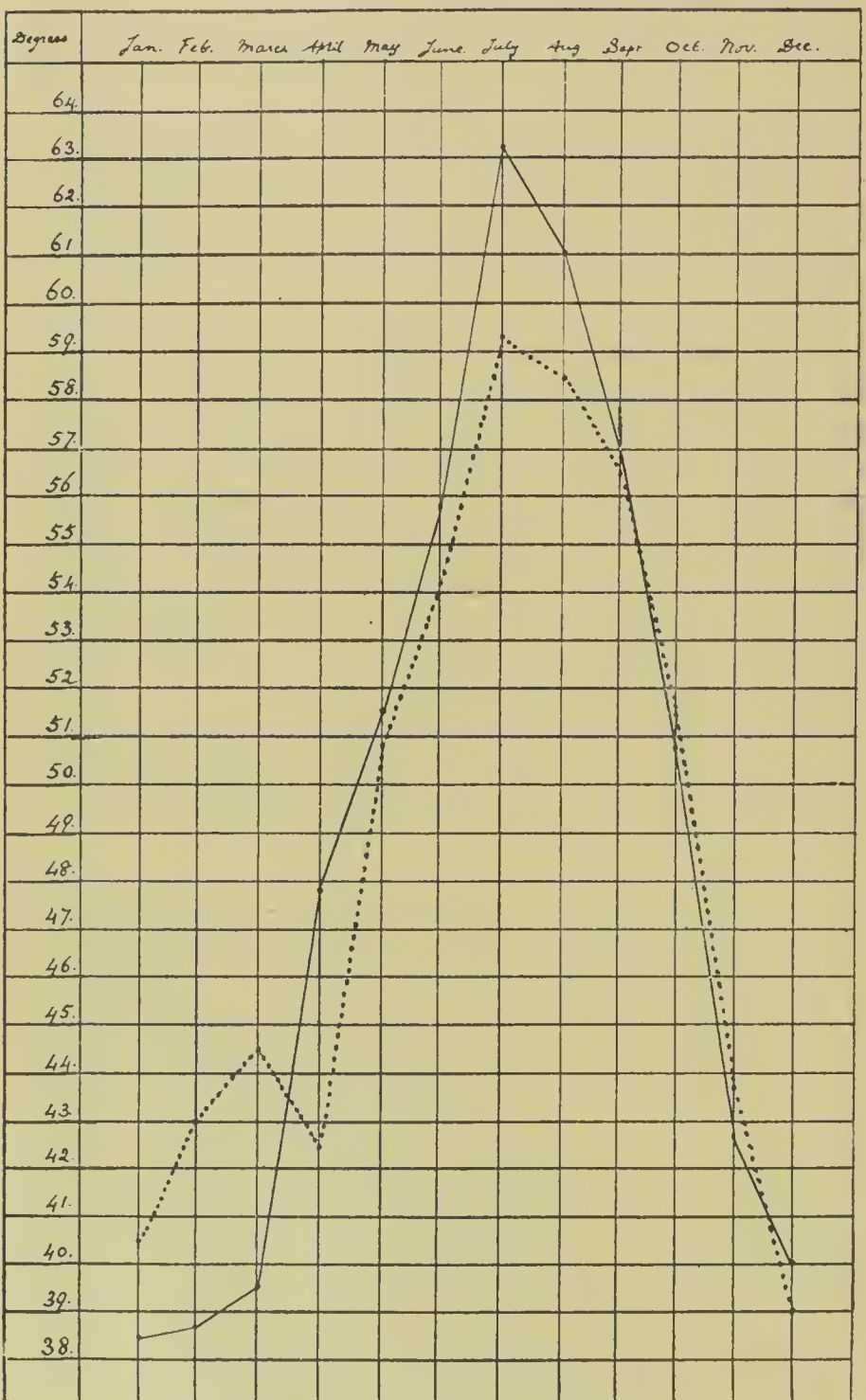


Diagram 2.—Curves showing mean temperature of each month of the years 1903 and 1904. Dotted line 1903, unbroken line 1904.
(From the Weekly Weather Report of the Meteorological Office for East England.)

earlier in 1903 than in 1904. As the temperature curves show, the first three months of 1903 were much warmer than those of 1904. The bitterly cold April does not seem to have had any appreciable effect, except to have delayed such species as had not already hatched—such as *Ceriodaphnia megalops*.

So far as observations have gone during the present year they show the probability of an early hatching like 1903. For instance, *Sida crystallina* and *Peratacantha truncata* have already been seen (March 15). Now the mean temperature of the first fifteen days of March this year is 43.9 (from observations at Sutton Broad Laboratory), so that it may be assumed that the "hatching temperature" for the majority of species is a mean of about 43° F.

But, just as the species appeared earlier in 1903, so they disappeared on the whole earlier in that year. Eight species disappeared earlier and three later. Such a difference is not so easy to explain. It was, perhaps, due to the generally colder summer of 1903, since there was practically no difference in temperature in October and November. On the other hand it is quite possible that each species tends to multiply only for a certain definite number of generations, so that if it appeared earlier it would also disappear earlier.

The occurence and intensity of the sexual periods in the

	First Record.		Last Record.	
Name of Species.	1903.	1904.	1903.	1904.
Sida crystallina - - -	March 22	May 26	Nov. 19	Dec. 7
Diaphanosoma brachyurum -	April 25	June 16	Oct. 24	Oct. 13
Scapholeberis mucronata -	April 9	May 31	Oct. 24	Nov. 8
Ceriodaphnia reticulata -	Feb. 26	April 17	Nov. 29	Dec. 6
,, megalops -	June 23	May 26	Nov. 8	Nov. 11
,, quadrangula -	Feb. 24	March 3	Dec. 4	Nov. 23
,, pulchella -	May 15.	May 3	Dec. 18	Nov. 17
Camptocercus rectirostris -	May 10	May 26	Nov. 17	Dec. 6
Lynceus costatus - - -	March 12	March 13	Nov. 17	Dec. 7
,, rostratus - - -	April 4,	April 14	Nov. 15	Nov. 29
Graptoleberis testudinaria -	March 16	March 14	Nov. 19	Dec. 7
Peratacantha truncata -	March 12	June 4	Dec. 1	Nov. 29
Polyphemus pediculus - -	March 22	April 17	Nov. 17	Nov. 29

Table No. 2.

two years show little difference, and the curves closely correspond (diagram 1). There is one difference which is very striking, namely, that the autumn maximum in 1904 comes a month later than in the previous year. As a matter of fact there are, as it were, two maxima in 1904, the one in October corresponding to, but being less than that of 1903. But, instead of a fall at once ensuing, the number of individuals sexual continued to increase in November. It does not seem possible to assign temperature as a cause of this difference, though one would be inclined to assume that it was due to more favourable conditions of existence prevailing. There must be other factors, the influence of which require study, such as sunlight, the composition of the water, and the abundance of vegetation.

The only previous attempt made in England to study the periodicity of the Cladocera in any given area is that of Mr. Scourfield (1898*), and as his results differ in some respects from my own a few comparisons may be of interest.

His results are based on 414 collections extending over a period of seven years, and made in and around Epping Forest. He found that the Cladocera reached their maximum number of species in September, and their minimum in January, "with a marked reduction in August." In Norfolk also the maximum is reached in September, but the minimum occurs in February, and there is no fall in August. Here are the numbers of species for the two years combined:—

Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
25	21	26	33	40	42	45	47	53	51	41	31

These differences are probably attributable to the locality; since Mr. Scourfield dealt only with ponds, which would be more affected by heat in summer and cold in winter than the broads are. Otherwise his results agree very closely with my own, though there is evidently a more marked spring sexual period in the Epping district than in Norfolk—a difference also probably connected with the size of the ponds.

Whether external conditions can directly influence sexual reproduction is a question that requires further investigation.

* 'Essex Naturalist,' vol. x. 1898.

Weismann, to whom we owe most of our knowledge of this Cyclic reproduction, concluded that the time of appearance of sexual individuals is not determined by external conditions, but by some internal factor. He found that in all the species which he closely investigated these individuals appeared at certain determined generations. The first generation hatched from the resting eggs is always parthenogenetic, but males and ephippial females may appear in the second generation, as in *Moina rectirostris*, or in any one of the following generations according to the species. The resting eggs deposited by the individuals of the first cycle lie dormant for a time and give rise to the second autumn cycle. Such a definite law, namely, that sexual individuals appear at a determined generation only, unaffected by external conditions, does not, I think, express the whole truth. In the Arctic regions the cycle is very much shorter than in the south (Ekman, 1904); in fact, several species there have only a single parthenogenetic generation, and it is fair to assume, in the absence of proof to the contrary, that the length of the cycle is, as it were, a plastic thing moulded by the climate.

The fate of individuals which survive the winter is of particular interest in this connection. According to Weismann their progeny should continue to reproduce parthenogenetically till they die out. I have followed the fate of such an individual of *Daphina longispina*. A single female was taken on February 6, 1903, and the history of her progeny was followed in detail to the seventh generation in August and less completely till October 13. Reproduction was at first very slow, so that the individuals of the third generation did not produce young till May 10. The five individuals then under observation all began on or about that date to produce sexual young, and three of them themselves became ephippial. For the rest of the time till August males were occasionally born and ephippia produced. In collections made at Sutton sexual individuals were first found on May 8, and continued to occur till the end of July. The correspondence is very striking and must be explained as showing the influence of temperature, as there could be no question here of a definite number of generations.

I believe that further experiments will show a direct connection of the sexual cycle with the season, determined probably by the average temperature, and that the sexual individuals of the second (autumn) cycle are not wholly, or even largely, derived from the resting eggs of the previous cycle, but are their descendants by agamic reproduction.

There is one more question to discuss. Which is the original method of reproduction, sexual or asexual ? I cannot go at length into this question, and will only say that the evidence is strong that originally sexual reproduction with resting eggs was the rule. That parthenogenetic reproduction arose and prevailed from the advantage conferred by reason of the greater rapidity of multiplication made possible by it. By multiplying individuals before the production of resting eggs set in the species was more assured of persistence. In some cases agamy has supplanted amphigony, but generally it has been necessary to preserve the faculty of producing winter eggs. The conditions which we see now in regard to cyclic reproduction of each species and in each country are to be regarded as adaptations to the necessities of the situation and of the species.

VI.

A STUDY OF THE AQUATIC *COLEOPTERA* AND THEIR SURROUNDINGS IN THE NORFOLK BROADS DISTRICT.

By Frank Balfour Browne, M.A., F.R.S.E., F.Z.S.,
Director of the Sutton Broad Laboratory.

Read February 28th, 1905.

A year ago I read a paper before this Society in which I attempted to lay down a scheme of work for the investigation of bionomical problems in our district. The scheme

was to first discover the local distribution or localisation of species, and then to inquire into the cause of such localisation. I referred to the results of my first year's work in the district, and showed that there was a very distinct localisation in the case of most of the species of the thin-bodied Dragon-flies, some having their centre of distribution in the eastern part of our district, others in the western part, while one or two species were confined to very circumscribed areas.

I have continued these observations upon the Dragon-flies during the past season, and have noted one or two changes in the distribution of the species, but I have made no attempt to consider the question of causes, deeming it best to continue the observations for several years before going further, because, in a group such as this, the material is necessarily scanty, and it is only by the accumulation of facts that we can hope to discover the localising agencies.

One further reference to my last year's paper before I proceed to the subject in hand. It may be remembered that I proposed to divide up the whole district arbitrarily into twenty-four sub-districts, without any reference to faunistic or physical characteristics. After further consideration, and also after consultation with several members of this Society, I have come to the conclusion that such a division is both inconvenient and unnecessary; inconvenient because, without publishing a somewhat detailed map, there is no way of concisely defining the sub-districts, and unnecessary because the parochial divisions of the district would seem to be quite as suitable as those which I proposed to make. Further, I am now uncertain as to the utility of any such division under all circumstances, and I propose in this paper to sub-divide the district according to the exigencies of the case.

Now to come to the subject in hand. During the past season I have been collecting the Water Beetles of the Broads district. I commenced the work in February, selecting certain areas of ground, in the dykes and pools of which I made collections. I revisited these stations as far as possible month by month until November, and also collected

at many of the same places in successive months. By this means I was enabled month by month to compare the faunas in a number of the collecting places. The total number of collections made during the ten months was 1079; but in working up the material the February collections have in most cases been omitted as they were very few in number, and in some of the calculations the November collections have also been omitted, chiefly because many of the species had then disappeared from the collecting places.

I will here explain what I mean by a collection: A collection consists of an indefinite number of sweeps of the water-net in a pool or pond or length of dyke until no more species appear to be present. The collecting-place may be as much as thirty yards of a dyke or ditch, or as little as five yards; it may be a pond ten yards across, or a pool two feet square. In the larger places it may take from half an hour to an hour before the number of species seems to be exhausted; in the smaller places a quarter of an hour may suffice, though very often the smaller places are more richly stocked than the larger ones, if not in species at least in individuals.

At the commencement of the work it was necessary for me to take home whole collections of 100, 200, or even more individuals in order to identify the species, as many of them I had never seen before, and from want of practice it was often difficult to be certain as to the identification of some of the commoner kinds. As time went on, however, I came to know most of the species at a glance, and gradually the number of individuals which required special scrutiny became fewer, and I was consequently enabled to make more collections during the day. Complete lists of every collection were made as to species, but not as a rule as to number of individuals. This latter was done in most cases at the commencement of the work, but only in special cases later on when some particular importance appeared to attach to it.

Now this systematic method of collecting has, I believe, not been carried out before. As a rule, those who make collections of insects are either systematists or morphologists,

or what Darwin called "Naturalists without souls," and our knowledge of the time of duration in the imago state, the commonness or rarity, and the localisation of the species depends largely upon the casual observations made by these classes of collectors. How far such observations were accurate at the time they were made it is not possible now to say, but, after looking through records of collecting excursions published in the various entomological journals, inadequate observations seem to me exceedingly numerous. In the first place, a large number of such records leave out all reference to the commoner species, or I find such a remark as "most of the species observed were (with one or two exceptions) similar to those found at Braemar,"* a statement which is of course utterly valueless. I think the insufficiency of the records results largely from the fact that most collectors pick up the species they want, and do not, at any rate on the spot, note down the species they see.

Upon such imperfect material as this our catalogues of local faunas are to a great extent based, and such works are of less value from the fact that the time of year at which the species were observed is often only mentioned for the rarer kinds. No doubt the lists are fairly accurate as to the species present in the locality, but we require more careful observations as to the time of duration and commonness or rarity of each species, observations which are essential if we are to get any insight into the relationships between living things.

As an example of the result of incomplete observations, I will refer to our Norfolk list of Coleoptera, compiled by Mr. Edwards, and published in our Transactions, Vols. V. and VI. I only refer, of course, to the Water Beetles, as I have only been studying that group.

In this list I find *Hydroporus erythrocephalus*, L. described as "common," while *H. planus*, F. is described as "very common." In the Broads district during the past season, from March to November inclusive, the former species has

* Coleoptera at Aviemore. G. C. Champion. Entom. Monthly Magazine, vol. xi. p. 64. 1874-5.

occurred in 57 % of all the collections, while the latter has occurred in 14 %. *H. planus*, in its best month, November, was present in 28 % of the collections, while *H. erythrocephalus* was less common in May than in any other month, when it occurred in 46 % of the collections.

Again, *Hydroporus gyllenhalii*, Schiödte, is described in the Norfolk list as common, while two localities only are given for *H. granularis*, L., which therefore is presumably to be considered as either rare or very local. From March to November of last year *H. gyllenhalii* did not occur in any month in as many collections as did *H. granularis*, its best percentages being in March and May (18), while *H. granularis* was at its lowest percentage, 16, in June, and occurred in 33 % of the collections in September and October.

In the same list *Agabus bipustulatus*, L., *A. chalconotus*, Panz, and *A. sturmii*, Schön, are all described as abundant, although the first was more than twice as common as the last, and five times as common as the second in the Broads district last season.

However, it is not my object to discuss the insufficiencies of the Norfolk list, but to point out that such a list, which is typical of most local lists, is of little use as a basis for working upon. We are not told the years or the months in which the records were made, and it is common experience that species are continually changing their habitats and varying in abundance.

However, a very novel and unscientific use has recently been made of this Norfolk list by Mr. Claude Morley in a paper published in the last number of our Transactions. Mr. Morley published a list of the *Coleoptera* of Suffolk in 1899, and in the paper to which I refer, he endeavours to compare the Beetles of that county with those of Norfolk.

Our county list was published in 1893, and although several supplementary lists have appeared since then, only one, published in 1899, adds any species to the list of Norfolk Water Beetles, and of the four records there mentioned, one or two are old ones which had been overlooked when the

original list was compiled. Mr. Morley has taken this list and compared it with his Suffolk list of 1899, to which some additions have more recently been made. He states that fourteen species of Water Beetles—*Hydradephaga* and *Palpicornia*—occur in Suffolk which do not occur in Norfolk. Three of these species were taken in Suffolk for the first time in 1902, and as to one of these, *Hydroporus bilineatus*—I presume of Sturm, although Mr. Morley has neglected to add the author's names to the species all through his list—I have been unable to ascertain on whose authority it was introduced. The species had previously only been taken in a brackish ditch at Deal, where it occurred once in some numbers, and I understand that the Suffolk record is for a specimen or specimens taken inland at Tostock.

Seven of these fourteen species supposed to be peculiar to Suffolk have occurred in the Norfolk Broads district during the past season. If 50 % of Mr. Morley's statements as to the Water Beetles are wrong, how are we to credit the rest of the paper ?

All that can be learnt from most of the local lists as at present composed is that a species *has* occurred in the district. For the purpose of learning anything as to the phenology of the species, or as to the influences determining their range of distribution, such lists are valueless, and one must set about the task of collecting the species systematically.

During the past season I have found in the Broads district seventy-two species of *Hydradephaga* out of the eighty-five recorded for the county, and have added four other species. Out of the fifty-three species of *Palpicornia* recorded for Norfolk, not including the genera *Sphæridium*, *Cercyon*, *Megasternum*, and *Cryptopleurum*, of which the species are mostly more common on land, I have found thirty-six and have added five other species. My list, therefore, for the ten months, February to November, includes 117 species, as I have not included the *Gyrinidæ* in my work, their mode of life being entirely different to that of the other two groups.

I have worked out the number of species per collection

in each month, and also the number of species captured in each month, and the results are represented in the following charts :—

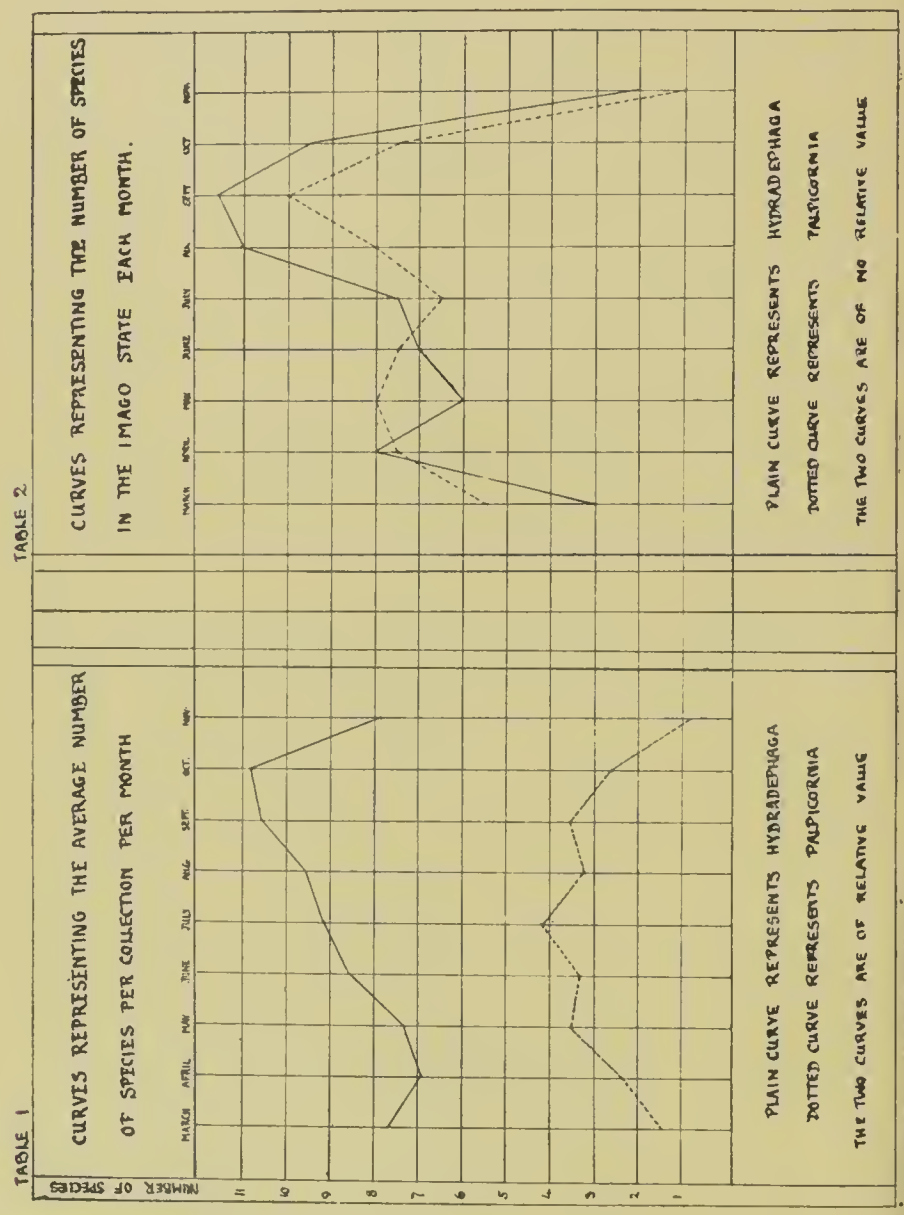


TABLE 1
CURVES REPRESENTING THE AVERAGE NUMBER OF SPECIES PER COLLECTION PER MONTH
NUMBER OF SPECIES
MARCH APRIL MAY JUNE JULY AUG. SEPT. OCT. NOV.
11 10 9 8 7 6 5 4 3 2 1
PLAIN CURVE REPRESENTS HYDRADEPHAGA
DOTTED CURVE REPRESENTS PALPICORNIA
THE TWO CURVES ARE OF RELATIVE VALUE
TABLE 2
CURVES REPRESENTING THE NUMBER OF SPECIES IN THE IMAGO STATE EACH MONTH.
MARCH APRIL MAY JUNE JULY AUG. SEPT. OCT. NOV.
PLAIN CURVE REPRESENTS HYDRADEPHAGA
DOTTED CURVE REPRESENTS PALPICORNIA
THE TWO CURVES ARE OF NO RELATIVE VALUE

Now from these charts we can learn two important things: First, we can learn *the distribution* of the species in the district from the table showing the number of species per collection,

because the more species there are in each collection the more the individuals of each species must be spread about. Secondly, we can learn the hatching periods of the species—that is the hatching out of the imagos—from the table showing the number of species captured each month. Thus, when we find that there is a rise in number of species in the spring, followed by a fall in number in the summer, and again by a marked rise in the autumn, we can conclude that there have been two definite hatching periods. This, of course, does not exclude the probability of some species hatching at other times, but it indicates that the majority of species appear in the imago state at two definite periods of the year, in the spring and in the autumn.*

With this explanation it will be seen that the *Hydradephaga* are most widely distributed in October, and that in September most of the species are in the imago condition. Although there is a spring hatching of species in April, when sixty-four of the seventy-six species are represented, the number of individuals at that time is either small or is contained in but a small proportion of the collections. Although after April some of the species apparently disappear, the process of distribution goes on uninterruptedly until the autumn.

In the *Palpicornia* there is also a spring and an autumn hatching of the species. The process of distribution, however, differs materially from that of the *Hydradephaga ;* whereas in the latter, distribution reaches its maximum in October, the maximum for the *Palpicornia* is in July, and whereas in the *Hydradephaga* the spring hatching takes place at much fewer stations than the autumn hatching ; in the *Palpicornia* the spring and autumn hatchings take place at about the same number of stations.

The difference in the process of distribution in the two groups is perhaps to be explained by the different mode of life in the two groups. The *Hydradephaga* are, both in their larval and perfect states, animal feeders, living upon insects, entomostraca

* The spring hatch of course includes the re-appearance of a number of individuals which have hibernated, but there appears to be an emergence from the pupal instar of many of the species at this period of the year.

worms, and such forms, whereas the *Palpicornia*, although animal feeders in their larval condition, are vegetable feeders in their perfect state.

Now the various forms of lower animal life in the water are abundant all through the summer and autumn, but die off very rapidly about the end of October. They are more or less scarce through the winter, but the numbers begin to increase again when the temperature becomes suitable in the spring. The *Hydradephaga*, therefore, can find food almost everywhere during the summer and autumn, so that the tendency of the individuals to wander receives no check. The species which hatch in the early part of the year spread over the district, and the maximum of species in the imago state in September is not due to the appearance of new species so largely as to the hatching out of a second generation, for very few of the species recorded in September have not been recorded in other months also.

If then, as I believe, the distribution curve for 1904 shows what takes place annually, why is the distribution of species in spring so poor after the promising autumn distribution ?

The only suggestion I can make is that winter conditions directly or indirectly kill off imagos and larvæ of the various species in those stations to which they have spread during the summer, so that each spring the process of distribution begins again from the comparatively small number of stations at which the larvæ, or in some cases the imagos, have survived.

Now plants, upon which the imagos of the *Palpicornia* depend for their food, carry out all their development in the spring and early summer, and by August and September, flowering being past, they are no longer succulent and sweet, and the leaves and stems have become coated with minute organisms, giving them a muddy appearance.

The spring hatch of the imagos of the *Palpicornia*, which takes place in April and May, sees the commencement of the process of distribution. Food is plentiful, and the insects can find fresh green leaves in most of the dykes and ditches. After July, however, the food in many places

becoming unsuitable, the Beetles again begin to congregate in the more favourable places, so that in September, although more species are in the imago condition than were so in the spring, the range of distribution is about the same as it was in May. Thus the places where the species are found in the autumn are their normal habitats, and there they will again appear in the spring.

Now this process by which a species adds to its distribution area at one period of the year and is as it were driven in upon its centre at another is very interesting, but where do all the individuals come from which fill all the summer stations ?

In various families in the animal kingdom, but especially among insects, one hears of or sees every now and again some particular species appearing in abundance. Every now and again some Butterfly or Dragon-fly or Beetle suddenly appears in hundreds or thousands, as if from the sky, and again almost as suddenly disappears, or rather, becomes normal again in its numbers. If one collects Water Beetles systematically month by month, one finds not uncommonly some spot where a particular species occurs in abundance. In some cases this same spot may be visited month by month and the same species will be found there more commonly than anywhere else, but in other cases—and this is much more usual—this spot which was crowded with a particular species last month will not yield more than a few individuals of it this month.

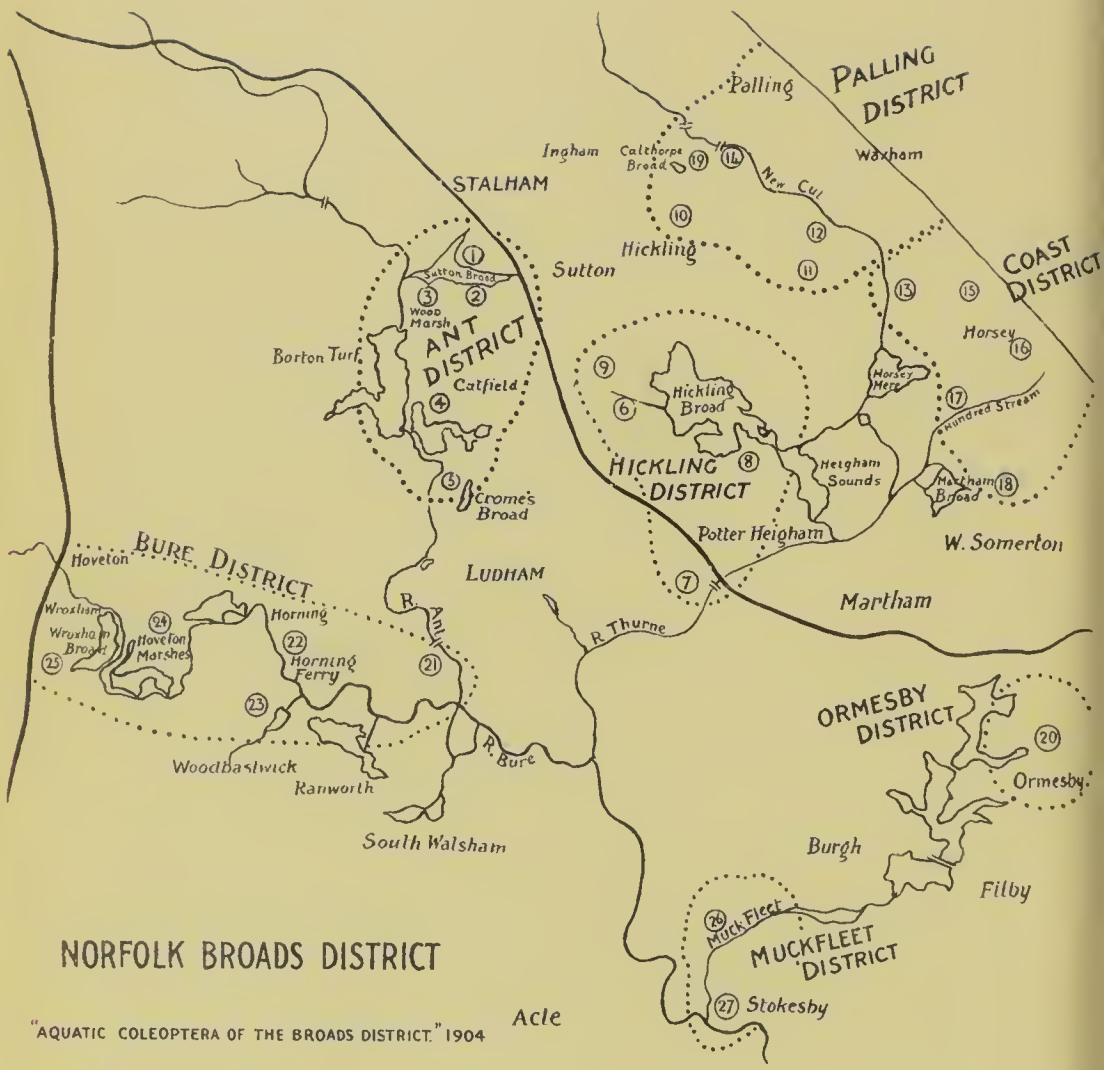
It seems to me that this phenomenon is identical upon a small scale with what we may call the plagues of insects, which from time to time force themselves upon the notice of the casual observer. Whereas, however, such plagues are due to abnormal reproduction, and, fortunately, only occur occasionally, owing, as is usually said, to some upset in the balance of nature, the former phenomenon is the normal result of the reproduction of the species. The "plagues" of insects are probably useful in renewing the distribution of the particular species from the plague centre. The excessive numbers of individuals put food at a premium, and death or

dispersal are the only alternatives. Without doubt large numbers die off, but others no doubt take their chance in new regions.

So, on the small scale, the individuals of one of the normal crowds devour all the food in their immediate neighbourhood and then spread over the land in search of more. The places where these normal crowds occur are then the centres of distribution of the species concerned.

I have observed more than fifty such centres during the past season, all, with the exception of two or three, having been recorded in the spring or autumn. In some of these cases in which I counted the number of individuals of each species taken in the collection, the dominant species composed from 50 % to 60 % of the individuals, in one case even 69 %. Such cases of abundance were sometimes common to several collecting places at a station—as in the case of *Cælambus impressopunctatus* on the Hickling marshes—but were more commonly confined to one collecting place. To give a few instances of such abundance—in April, *Bidessus unistriatus*, an uncommon species, was exceedingly common on some flooded marshes in the Hickling neighbourhood, although in no other locality all through the season could I find more than two or three individuals in a collection. In the same month *Hydroporus neglectus*, also somewhat rare, turned up in such numbers in a ditch in Potter Heigham parish that I counted seventy in the collection. In May this species was common, but not abundant in the same ditch, and in the latter part of the year only one or two individuals could be found there each month. Again, *Philhydrus maritimus* was very plentiful at a collecting place in the Horsey parish in May, after which it became almost scarce there. Similarly *Hydræna testacea* appeared in abundance in a dyke at Sutton in September, where only one or two individuals had previously occurred, and where it was not to be found in October.

Most of the centres of distribution of the *Hydradephaga* were observed in March and April, and again in September and October, while those of the *Palpicornia*, of which I noticed only a few, were at the very end of April and in May, and in



"AQUATIC COLEOPTERA OF THE BROADS DISTRICT." 1904

the latter half of September, thus corresponding with the hatching times of the groups.

Now having endeavoured to indicate the process of distribution, I will turn to the consideration of the localisation of species within the district. In the first place of course the usual place to look for Water Beetles is in water, so a first step in localisation is simple. But it is not every piece of water that produces every species of Water Beetle, so that it is necessary to take some steps to discover the principles, if any, upon which further localisation depends.

With the object, therefore, of seeing whether one part of the Broads District is more suitable to some species than another part, I have grouped the various collecting places into stations, and the stations into sub-districts, each sub-district being composed of a group of stations situated nearer to one another than to those of other sub-districts, as will be seen from the accompanying map.

There are seven such sub-districts; as will be seen, their arrangement coincides fairly well with the physical characteristics of the locality. We have, for instance, the Ant and the Bure districts situated in the respective river valleys; the Muck-Fleet district just within reach of the salt tides which occasionally run up the river; the coast district, exposed to the easterly and north-easterly gales which bring in sand and salt spray, and the Hickling district continuous with the coast marshes, but somewhat protected from the sea winds by belts of trees; the Palling district, partaking of the nature of the Hickling and the coast districts, stations 10 and 19 being somewhat sheltered, while 11 and 12, although not so close to the sea as some of the coast stations, are exposed to the east; and lastly, the single Ormesby station, well protected on all sides by woods but within easy reach of the coast.

In these 7 sub-districts 975 collections have been made at the 27 stations, and 115 species of Water Beetles have been found. I have worked out from this material the percentage of occurrences of each species in each sub-district with a view to comparing one sub-district with another, and the result is seen in the following table.

No.	No. of Collections in each District :—	Ant.	Hickling.	Palling.	Coast.	Ormesby.	Muck Fleet.	Bure.
		236	179	217	87	67	70	119
1	Haliplus obliquus, F.	7·62	3·91	17·51	19·54	11·94	21·42	2·52
2	,, confinis, Steph.	21·61	10·05	21·65	16·09	1·49	10·0	6·72
3	,, flavicollis, Sturm	2·96	·55	1·84	6·89	4·47	5·71	5·04
4	,, fulvus, F.	19·49	5·02	7·83	2·29	19·40	—	2·52
5	,, variegatus, Sturm	5·50	1·11	5·06	—	1·49	11·42	—
6	,, ruficollis, De G.	76·27	54·19	63·59	80·46	70·14	95·71	79·83
7	,, lineatocollis, Marsh	16·94	8·38	28·57	52·87	16·41	74·28	21·0
8	Cnemidotus impressus, F.	—	—	4·14	1·14	7·46	5·71	12·60
9	Pelobius tardus, Herbst.*	—	—	—	--	—	—	—
10	Noterus clavicornis, De G.	14·83	·55	9·67	—	2·98	10·0	36·97
11	,, sparsus, Marsh	13·55	6·14	4·14	21·83	8·95	32·85	26·89
12	Laccophilus interruptus, Panz.	1·27	5·58	5·06	11·49	1·49	10·42	3·36
13	,, obscurus, Panz.	19·91	23·46	39·63	29·88	19·40	51·42	66·38
14	Bidessus unistriatus, Schr.	1·69	8·38	6·45	6·89	—	—	—
15	Hyphydrus ovatus, L.	31·77	30·72	20·59	11·49	10·44	35·71	43·69
16	Cœlambus versicolor, Schall.	—	1·67	4·14	12·64	—	1·42	—
17	,, inæqualis, F.	48·30	39·65	52·07	54·02	31·34	82·85	65·54
18	,, confluens, F.	—	—	1·38	—	—	—	—
19	,, parallelogrammus, Ahr.	—	—	—	11·49	—	—	—
20	,, impressopunctatus, Schall.	·42	3·35	11·52	6·89	—	—	—
21	Deronectes dissimilis, Payk.	—	1·67	18·89	5·74	2·98	11·42	5·04
22	,, depressus, F.	—	—	·46	4·59	—	—	—
23	,, 12-pustulatus, Ol.	—	—	·46	2·29	—	—	—
24	Hydroporus, pictus, F.	35·16	28·49	42·39	54·02	40·29	62·86	45·37
25	,, granularis, L.	37·71	26·81	18·43	3·44	52·23	—	24·37
26	,, lepidus, Ol.	5·93	·55	11·52	—	—	—	—
27	,, halensis, F.	—	—	9·67	—	—	—	—
28	,, dorsalis, F.	11·01	25·69	5·06	—	10·44	1·42	1·68
29	,, lineatus, F.	35·16	13·96	32·25	13·79	47·76	21·42	30·25
30	,, scalesianus, Steph.	5·50	—	—	—	—	—	·84
31	,, neglectus, Schaum.	5·50	10·61	2·76	—	—	—	3·36
32	,, umbrosus, Gyll.	41·52	32·40	9·67	8·04	28·35	1·42	20·16
33	,, angustatus, Sturm.	17·79	16·20	12·90	8·04	31·34	2·85	29·41
34	,, palustris, L.	68·22	62·01	63·59	55·17	56·71	91·42	83·19
35	,, incognitus, Sharp.	·42	6·70	—	—	—	—	4·20
36	,, vittula, Er.	34·74	31·28	14·28	9·19	32·83	1·42	20·16
37	,, memnonius, Nic	13·13	7·82	9·67	3·44	19·40	—	10·92
38	,, gyllenhalii, Schiödte	19·91	19·55	23·96	8·04	20·89	—	1·68
39	,, tristis, Payk.	—	8·90	4·14	—	—	—	—
40	,, oblongus, Steph.	5·93	—	—	—	—	—	4·20
41	,, melanarius, Sturm.	2·11	—	2·30	—	—	—	—
42	,, nigrita, F.	10·16	2·23	5·99	9·19	16·41	—	5·88
43	,, obscurus, Sturm.	7·20	43·57	14·74	—	—	—	—
44	,, erythrocephalus, L.	60·59	77·65	48·84	33·33	56·71	34·28	68·90
45	,, planus, F.	5·08	20·67	18·43	17·24	29·85	10·28	5·88
46	,, pubescens, Gyll.	61·44	60·33	59·90	47·12	29·85	4·28	63·86
47	,, lituratus, F.	·84	1·11	—	—	—	—	—
48	Agabus femoralis, Payk.	—	5·58	—	—	—	—	—
49	,, unguicularis, Thoms.	6·35	5·58	·46	1·15	7·46	—	1·68
50	,, bipustulatus, L.	42·37	60·89	42·85	25·28	46·26	11·42	45·37
51	,, nebulosus, Forst.	—	2·23	9·67	1·15	2·98	—	—
52	,, conspersus, Marsh.	—	—	—	11·49	—	—	—
53	,, chalconotus, Panz.	11·01	11·73	13·82	14·94	1·49	—	—
54	,, sturmii, Schön.	19·06	28·49	21·19	19·54	1·49	11·42	36·97
55	,, paludosus, F.	—	—	—	—	—	—	3·36
56	Ilybius fuliginosus, F.	2·96	1·67	7·37	9·19	5·97	—	9·24
57	,, fenestratus, F.	·42	—	·46	—	1·49	2·85	1·68
58	,, ænescens, Thoms.	—	—	2·76	1·14	—	—	—
59	,, ater, De G.	16·10	8·93	15·20	9·19	7·46	7·14	15·12
60	,, obscurus, Marsh.	12·71	9·49	7·83	8·04	10·44	8·05	8·40

* Pelobius tardus and Dytiscus circumcinctus did not occur at any of the stations considered in this table, but the name is inserted so that the list may contain the names of all species taken in the Broads District in 1904. Cœlambus decoratus, Gyll. almost certainly occurred in one or more of the districts, but was passed over as Hydroporus pictus F., by mistake.

No. of Collections in each District :—	Ant. 236	Hickling. 179	Palling. 217	Coast. 87	Ormesby. 67	Muck Fleet. 70	Bure. 119
1 Ilybius guttiger, Gyll.	8·47	3·35	·92	—	4·47	—	4·20
2 Copelatus agilis, F.	2·54	20·67	11·52	2·28	14·92	1·42	2·52
3 Rhantus grapii, Gyll.	8·47	6·14	1·84	—	2·98	—	6·72
4 ,, exoletus, Forst.	12·71	9·49	5·99	—	14·92	1·42	15·12
5 ,, pulverosus, Steph.	·42	1·67	—	—	—	1·42	·84
6 ,, notatus, Berg.	—	1·11	—	8·04	—	—	—
7 ,, adspersus, F.	—	·55	—	—	—	—	—
8 Colymbetes fuscus, L.	7·60	13·96	5·53	11·49	17·91	5·71	3·36
9 Dytiscus punctulatus, F.	9·74	5·02	2·76	2·28	4·47	1·42	4·20
0 ,, marginalis, L.	3·39	2·23	1·84	2·28	2·98	1·42	3·36
1 ,, circumflexus, F.	—	·55	—	6·89	--	1·42	—
2 ,, circumcinctus, Ahr.*	—	—	—	—	—	—	—
3 ,, dimidiatus, Berg.	·42	—	—	—	—	—	—
4 Hydaticus transversalis, Berg.	3·81	—	·46	—	10·44	2·85	1·68
5 Acilius sulcatus, L.	·42	2·79	·92	—	1·49	—	—
6 Graphoderes cinereus L.	·84	--	—	—	—	—	—
7 Hydrophilus piceus, L.	·84	—	·46	—	—	1·42	3·36
8 Hydrobius fuscipes, L †	21·18	25·69	24·88	32·18	41·79	7·14	31·93
9 ,, picicrus, Sharp	—	—	—	—	—	—	—
0 ,, oblongus, Herbst.	—	—	—	—	—	11·42	—
1 Philhydrus testaceus, F.	5·08	6·14	4·14	12·64	10·41	25·71	7·56
2 ,, maritimus, Thoms.	—	—	—	8·04	—	—	—
3 ,, nigricans, Zett.	13·55	13·96	14·28	27·58	19·40	22·85	7·56
4 ,, coarctatus, Gredl.	28·81	18·43	16·59	—	19·40	—	8·40
5 Cymbiodota ovalis, Thoms.	7·62	14·52	13·82	11·49	25·37	1·42	3·36
6 Enochrus bicolor, Gyll.	—	3·35	·46	1·15	--	17·14	·84
7 Anacæna globulus, Payk	16·52	23·46	9·21	13·79	37·31	2·85	15·82
8 ,, limbata, F.†	39·83	34·07	25·34	33·33	50·74	30·0	43·69
9 ,, bipustulata, Steph.	—	—	—	—	—	—	—
0 Helochares lividus, Forst.	—	1·11	—	—	—	—	—
,, punctatus, Sharp.	10·59	26·25	14·28	16·09	8·95	2·85	13·44
2 Laccobius alutaceus, Thoms.	7·20	6·70	8·75	22·98	32·83	27·14	26·89
3 ,, minutus, L.	--	·55	—	—	—	—	1·68
4 ,, bipunctatus, F.	11·86	10·05	14·28	19·54	13·43	55·71	33·61
5 Berosus luridus, L.	—	2·79	2·30	—	—	—	—
6 Limnebius truncatellus, Thoms.	5·93	2·23	3·68	—	2·98	--	2·52
,, papposus, Muls.	6·78	1·67	2·30	—	11·94	—	·84
,, nitidus, Marsh.	·84	—	·46	—	—	1·42	—
,, picinus, Marsh	12·28	1·11	1·38	—	10·44	—	1·68
0 Cilæta rthria seminulum, Herbst	6·35	—	·46	1·15	8·95	—	6·72
Helophorus nubilus, F.‡	·42	—	·46	—	1·40	—	84
,, aquaticus, L.	2·11	5·58	2·30	1·15	2·98	1·42	9·24
,, æneipennis, Thoms.	11·86	20·67	23·90	3·44	8·95	4·28	17·64
,, affinis, Marsh.	·84	1·11	1·38	—	4·47	1·42	—
,, brevipalpis, Bedel.	15·25	25·69	20·73	12·64	31·34	21·42	12·60
Hydrochus brevis, Herbst.	4·66	6·14	2·30	—	—	—	84
,, elongatus, Schall.	6·35	6·14	5·53	—	—	—	—
,, angustatus, Germ.	8·05	7·82	9·67	6·89	5·97	—	1·68
Octhebius margipallens, Latr.	1·27	11·17	4·14	8·04	—	—	·84
,, marinus, Payk.	·42	1·67	·92	8·04	2·98	—	—
,, pygmæus, F.	32·20	34·03	11·98	19·54	52·23	4·28	27·73
,, bicolon, Germ.†	4·23	7·82	·46	12·64	5·97	10·0	5·88
,, æratus, Steph.	—	—	—	—	—	—	—
Hydræna testacea, Curt.†	1·27	·55	·46	—	4·47	—	—
,, palustris, Fr.	3·81	—	—	—	—	—	—
,, riparia, Kug.	7·62	1·67	1·31	—	17·91	—	3·36
Cyclonotum orbiculare, F.	5·50	—	·46	1·15	11·94	—	·84

† In the table the records of Hydrobius fuscipes and picicrus, of Anacæna limbata and bipustulata, and of Octhebius bicolon and æratus are mixed. Also probably some of the records of Hydræna testacea should be referred to H. palustris.

‡ This species cannot be considered of any importance in the table because it is much more commonly found out of water than in it. Several other species, such as those of the genus Limnebius, and also Cyclonotum orbiculare, are also found in damp moss and such situations, so that their occurrences in water are not a sound criterion of their abundance.

Now it must be clearly understood before considering these percentages that the results are only indicative and are not to be taken as statements of fact. In such a comparison as I have made, where the conditions at each station are unequal, and where unequal numbers of collections have been made at each station, and where all sorts of unknown factors interfere, correct results are almost if not quite impossible; but I think if we use the results obtained only as an indication of probabilities they may prove useful as a guide for further investigations.

From a table such as this we can extract several things. In the first place the richness of each of the sub-districts in species, which is as follows :—

TABLE 4. SHOWING NUMBER OF SPECIES OCCURRING IN EACH DISTRICT.

Name of District	Ant.	Hickling.	Palling.	Coast.	Ormesby.	Muck Fleet.	Bure.
No. of Collections in each district.	236	179	217	87	67	70	119
Total Number of Species in all districts, 115	92	91	96	72	76	61	80

This result must, however, be taken with some caution, as the comparison is not quite fair, seeing that the Ormesby district had only 67 chances of showing its species while the Ant district had 236. That Palling district produced most species may perhaps be accounted for by the variety of its stations.

Secondly, it is possible to extract the average number of species per collection in each sub-district and the result is as follows :—

TABLE 5. SHOWING NUMBER OF SPECIES PER COLLECTION IN EACH DISTRICT.

Name of District.	Ant.	Hickling.	Palling.	Coast.	Ormesby.	Muck Fleet.	Bure.
No. of Collections in each district.	236	179	217	87	67	70	119
	12.38	12.35	11 26	9.96	12.93	9.11	11.44

But here again the result must be taken with caution, for by reference to the map it will be seen that the Ormesby district, which shows 12.93 species per collection, is represented by a single station, while no other district, except the Muck Fleet, has less than four stations. The collecting places within the Ormesby district are all contained within say half a square mile, while a much greater area is covered in all the other districts, and there would, therefore, probably be more similarity between the collecting places at Ormesby than elsewhere, which would account for the greater similarity in the Beetle fauna. This explanation will, however, only account for the probably false position of the Ormesby district, and it will be noticed that in both the tables the Coast and the Muck Fleet districts are at the bottom of the list, indicating poverty both in species and in distribution of the species within the districts. This cannot be due to the salinity of the water, because the water is slightly salt in some of the Palling stations and some of the Hickling stations, but I believe that it is due to one cause on the Coast and to another in the Muck Fleet district. I think that the exposure of the Coast district is probably the cause of its poverty, while in the Muck Fleet district the poverty is probably due to the changing salinity of the water. I have found here at one time a salinity of 235 grains per gallon,

while at another time in the same place the salinity has been as low as 19 grains per gallon.

Now if from the original table we separate out those species whose best record of occurrences is in the Muck Fleet district, we shall find that their occurrences in the other districts are as shown in the following table :—

TABLE 6. SHOWING THE DISTRICT-DISTRIBUTION OF THOSE SPECIES HAVING THEIR BEST RECORD OF OCCURRENCES PER 100 COLLECTIONS IN THE MUCK FLEET DISTRICT.

	Muck Fleet.						
HALIPLUS obliquus, F. -	21.42	19.54 Coast	17.51 Palling	11.04 Ormesby	7.62 Ant.	3.91 Hickling	2.52 Bure.
,, variegatus, Sturm.	11.42	5.50 Ant.	5.06 Palling	1.49 Ormesby	1.11 Hickling	—	—
,, ruficollis, De G. -	95 71	80.46 Coast	79.83 Bure	76.27 Ant.	70.14 Ormesby	63.59 Palling	54.19 Hickling
,, lineatocollis, Marsh. -	74.28	52.87 Coast	28.57 Palling	21.00 Bure	16.94 Ant.	16.41 Ormesby	8.38 Hickling
NOTERUS sparsus, Marsh -	32.85	26.89 Bure	21.83 Coast	13.55 Ant.	8.95 Ormesby	6.14 Hickling	4.14 Palling
CÆLAMBUS inæqualis, F. -	82.85	65.54 Bure	54.02 Coast	52.07 Palling	48.30 Ant.	39.65 Hickling	31.34 Ormesby
HYDROPORUS pictus, F. -	62.86	54.02 Coast	45.37 Bure	42.39 Palling	40.29 Ormesby	35.16 Ant.	28.49 Hickling
,, palustris, L. -	91.42	83.19 Bure	68.22 Ant.	63.59 Palling	62.01 Hickling	56.71 Ormesby	55.17 Coast
ILYBIUS fenestratus, F.	2.85	1.68 Bure	1.49 Ormesby	.46 Palling	.42 Ant.	—	—
HYDROBIUS oblongus, Herbst.	11.42	—	—	—	—	—	—
PHILHYDRUS testaceus, F. -	25.71	16.41 Ormesby	12.64 Coast	7.56 Bure	6.14 Hickling	5.08 Ant.	4.14 Palling
ENOCHRUS bicolor, Gyll.	17.14	3.35 Hickling	1.15 Coast	.84 Bure	.46 Palling	—	—
LACCOBIUS bipunctatus, F.	55.71	33.61 Bure	19.54 Coast	14.28 Palling	13.43 Ormesby	11.86 Ant.	10.05 Hickling

Thus *Haliplus obliquus*, which showed its best record in the Muck Fleet district, showed its second best record in the Coast district, its third best in Palling district, and so on. It is interesting to notice that out of the thirteen species showing their best record in the Muck Fleet district, five show their second best in the Bure district, four in the Coast district, and one each in the Ant, Ormesby, and Hickling districts.

If in the same way we separate out the species with their best record of occurrences in the Coast district we shall find that of the eleven species, four have their second best record in the Muck Fleet district, two in Palling, one each in Ormesby and Hickling, while three species occur nowhere else. If once again we separate out those species with their best record in the Bure district we find that of the nine species three have their second best record in the Muck Fleet district, two in the Ant, two in Ormesby, one in Hickling, and one in the Coast district.

Thus there is apparently a relationship between the aquatic Beetle fauna of the Muck Fleet and Coast districts on the one hand and between the Muck Fleet and Bure districts on the other.

If we further examine the percentage of occurrences of the species in the various districts we shall find that there is a similar relationship between the Ant and Ormesby districts, the Ant and Hickling districts, the Ant and Bure districts, and so on.

Now how can such relationships be accounted for? Where two districts lie next one another, as in the case of the Ant and Hickling districts, it is perhaps natural that the faunas should to some extent overlap, but such an explanation cannot account for the relationship between the Muck Fleet and Coast districts or between the Ant and Ormesby districts.

I think that in a general way explanation is possible. Taking the case of the Muck Fleet district, I have already mentioned that it is within reach of the salt water, of which it occasionally gets plenty. This saltness, occasional though it be, may perhaps account for the presence of such species as

Hydrobius oblongus, *Enochrus bicolor*, and *Dytiscus circumflexus*, which though not necessarily confined to brackish water, are more commonly found in it than elsewhere.

If this explanation of the relationship between the Muck Fleet and the Coast districts is correct, how is it that the Bure species are for the most part poorly represented on the coast? *Ilybius fuliginosus*, generally more common in running than in stagnant water, is the only species with its best record in the Bure district, which has its second best record in the Coast district, every other such species having a worse than third best record in the latter district.

I believe that the explanation of this apparent anomaly is that shelter, presumably in the form of temperature, is the localising factor with a number of the species, and that those which can withstand the varying salinity of the Muck Fleet district cannot withstand the exposure of the Coast district. Such an explanation would account for the relationship between the Ormesby, Ant, and Bure districts, which are widely enough separated and yet in which 26 out of the 46 species having their best record in one of these districts have their second best record in another of them, and in which only one, already referred to, has its second best record on the Coast.

Further, such an explanation would account for the relationships of the Hickling district. As I have said, this district is fairly well sheltered from the east by belts of trees. The water is slightly saline, but the salinity is, I believe, not very variable. Out of the nineteen species with their best record in this district, four show their second best in the Ant district, three in the Bure district, and two in Ormesby district, apparently indicating that shelter is important to them, but that salinity does not affect them, while three show their second best record on the Coast, apparently indicating that shelter is less important than salinity.

Thus it seems to me that the occurrence of the species in the various sub-districts suggests that a number of them are distributed according to opportunities for shelter, while some few seem to be more dependent upon the salinity of the water.

If then there is in such a district as that of the Norfolk Broads a sub-district distribution, perhaps mainly dependent upon available shelter, there are undoubtedly factors which further localise the species within the sub-districts. Some species for instance, such as *Agabus paludosus*, *Ilybius fuliginosus*, and *Deronectes depressus*, apparently occur most commonly in clear running water; others again, such as *Agabus nebulosus*, prefer stagnant ponds. Others, such as *Ilybius guttiger*, *Hydroporus umbrosus*, and *oblongus*, are perhaps commonest on mossy, marshy ground where water is scarcely visible above the vegetation. But even so, a habitat to all appearances eminently suitable for a certain species does not necessary hold that species. For instance, *Hydroporus scalesianus* occurs not uncommonly in certain patches of mossy marsh at Sutton and at Catfield Fen, but not, so far as I have been able to find, on similar ground most suitable in appearance in other places.

The factors which produce such fine distinctions in localisation are for the most part unknown. Many factors such as light, temperature, salinity, or other chemical conditions of the water, as well as the presence or absence of certain species of animals or plants combine to produce a suitable habitat, but the absence of any one of these is probably sufficient to make a habitat unsuitable.

One extremely interesting case of localisation has occurred at the station known as the Palling Brick Pits. The collecting place is a large pit sunk below the level of the surrounding ground. In this pit is a series of moderately sized ponds in the gravelly sand where clay has been dug for the brick-making. These ponds are mostly separate units in the summer, but in the winter many of them are connected owing to the rise of the water. The ponds in the eastern part of the pit are however always a separate series from those in the western part. The western series are rather deeper than the eastern, but otherwise there is nothing striking to distinguish them. The water is clear, and numerous plants such as Hottonia, Anacharis, Callitriche, Potamogeton natans grow in various ponds in both series. Yet the distri-

bution of Water Beetles in this pit is very marked. Omitting those species of which only a few individuals occurred during the season, two species are peculiar to the western ponds and five to the eastern, while five are markedly more common in the western than in the eastern, and twelve in the eastern than in the western. Now in an area of ground, perhaps 200 yards long by 50 yards wide, the discovery of such a localisation can scarcely be considered imaginary when it is the outcome of regular monthly observations from April until November and the result of sorting out 74 collections, 32 from the western ponds and 42 from the eastern. Including all species, 55 occurred in the eastern ponds and only 38 in the western.

Now the pit is fully exposed to the east winds, and the banks are scarcely sufficient to form a protection to any of the ponds. There is however one fact which I learnt in conversation with the foreman of the brick-works which may have some bearing upon the localisation of the Beetles. The sand in the western part of the pit is unsuitable for using in the brick-making owing to its coarseness and all the sand used in the works is taken from the eastern end. This difference in the nature of the sand at the two ends of the pit may of course have nothing to do with the distribution of the beetles, but it seems reasonable to believe that it may affect them either through their food or in some other way.

It has seemed to me more than once that the orientation of a dyke may affect the distribution of the species, for when a dyke turns off at right angles to its original course I have several times noticed that a species which in one branch was common was either absent or scarce in the other branch. Possibly in considering the direction in which a dyke runs we are coming back to a question of temperature; but I have so far made no attempt to verify this. I have, however, occasionally compared the temperatures of some of the dykes in which I have been collecting, and have found differences even to 5° Fahrenheit. I hope, however, to pay more attention to this part of the subject during the present season.

Now there are possibly groups of species governed as to their distribution by definite sets of determining factors,

but it would be exceedingly difficult to arrange the species into associations with any accuracy by separating them according to their habitats. A method has, however, occurred to me by which it seems possible to determine which species are more commonly associated together, and as this method depends upon statistics and not upon impressions, I believe it is reliable.

From complete lists of the species of every collection we can quite easily extract the percentage of occurrences of all the species in all the collections. Similarly, if we separate out all collections containing a certain species "A," we can extract the percentage of occurrences of all the species in the "A" collections, that is, we can find out how many times each of the other species has occurred in company with "A."

We have not, however, in such a series of figures got the true value of each species as an associate of "A," because those species which exceed "A" in number of occurrences in the general collections *can* occur in 100 % of the "A" collections, while a species scarcer than "A" in the general collections *cannot possibly* turn up in 100 % of the "A" collections. We must therefore find the value of each species as an associate of "A" in terms of its own commonness in the general collections. Perhaps this can be made clear by an illustration.

Species "A" occurs in 50 % of all collections and we wish to find the values of "B," "C," and "D" as associates of "A." Species "B" occurs in 75 % of all collections, "C" in 20 % and "D" in 15 %. Now since "B" occurs in more of the general collections than "A" does, the largest percentage that it could show in the "A" collections would be 100. On the other hand, "C" only occurs in 20 out of every 100 general collections, and therefore cannot possibly turn up in more than 40 % of the "A" collections. Thus if "B" occurs in all the "A" collections it occurs in 100—75, *i.e.*, 25 % more of the "A" collections than of all the collections, while if "C" occurs in 40 % of the "A" collections, the best it can do, it occurs in 40—20, *i.e.*, in 20 % more of the "A" collections than of the general collections. It appears therefore as if "B" were more important than "C" as an

associate of "A," although both species have appeared in the "A" collections their maximum number of times. "B's" 25 therefore should equal "C's" 20. Both values must therefore be brought to a common series which is of course done by dividing each by itself and thus bringing them to unity. For simplicity it is perhaps better to work in hundreds, reckoning the maximum possibility in each case as 100.

Thus if "B" occurs in 90 % of the "A" collections its value is 90—75, *i.e.*, 15 % in favour of "A." This, if multiplied by 100 and divided by the maximum 25 already determined will give us 60 % as the true value of "B" in the "A" collections. Similarly if "C" occurs in 35 % of the "A" collections its value is 35—20=15 % in favour of "A," and by multiplying this by 100 and dividing by the maximum 20 already determined we shall get 75 % as the true value of "C" in the "A" collections.

Now if "D" occurs in only 8 % of the "A" collections its case is somewhat different from that of either "B" or "C." Had it occurred in 15 % of "A" collections its value in favour of "A" would have been 0 because it would have been equally common in the "A" and in the general collections. Since it occurs in less than 15 % of the "A" collections its value to "A" is less than 0, or a minus quantity. If it had not occurred in any of the "A" collections its value to "A" would have been —15, the lowest possible. Just as we converted the maximums into 100 so we can convert the minimum, and —15 becomes —100 %. Thus multiplying the 8 % by 100 and dividing by the minimum 15 will give us 53 % as the value of "D" in the general collections, that is, — 47 % as the value to "A."

By this process we can trace the relative value of every species as an associate of every other species.

I have not yet carried the investigation far in this direction, and my object now is to bring the method before you rather than to attempt to divide up the various and complex associations of Water Beetles. However, in order to show you the application of the principle I have worked out the values

of the species of *Hydradephaga* in three cases, those of *Hydroporus pictus*, *H. granularis*, and *H. gyllenhalii*, and the following table, in which only species showing a plus value and which occurred in more than 1 % of all collections are included, is the result :—

TABLE SHOWING THOSE SPECIES WHICH ARE ASSOCIATED WITH HYDROPORUS PICTUS, GRANULARIS AND GYLLENHALII.

Hydroporus Pictus, F.		Hydroporus granularis, L.		Hydroporus Gyllenhalii, Schiödte.	
Nemidotus impressus	75	Ilybius guttiger	55	Hydroporus tristis	100
Cœlambus versicolor	67	Hydroporus oblongus	50	,, pubescens	65
Hydaticus transversalis	67	,, erythrocephalus	44	,, neglectus	61
		,, umbrosus	40	Agabus chalconotus	54
Haliplus ruficollis	63	,, angustatus	33	,, bipustulatus	45
Peronectes assimilis	60	,, memnonius	33	Hydroporus nigrita	30
Laccophilus interruptus	57	,, nigrita	33	,, memnonius	27
Haliplus fulvus	45	Hydaticus transversalis	28	Copelatus agilis	25
Hydroporus palustris	44	Copelatus agilis	28	Agabus unguicularis	18
Haliplus obliquus	40	Hydroporus vittula	27	Ilybius guttiger	18
Hydroporus lepidus	40	,, pubescens	23	Dytiscus punctulatus	18
Hyphydrus ovatus	35	Haliplus variegatus	22	Hydroporus vittula	17
Cœlambus inæqualis	35	Agabus unguicularis	22	Hydroporus granularis	9
Haliplus confinis	33	Hydroporus dorsalis	20	,, umbrosus	9
Laccophilus obscurus	32	Bidessus unistriatus	17	Ilybius ater	8
Haliplus flavicollis	25	Rhantus grapii	17	,, obscurus	7
,, lineatocollis	25	Hydroporus obscurus	15	Hydroporus angustatus	5
Hydroporus lineatus	22	Ilybius obscurus	15	,, planus	5
Rhantus grapii	20	Haliplus fulvus	12	Cœlambus impressopunctatus	2
Bidessus unistriatus	20	,, ruficollis	11		
Hydroporus angustatus	18	Noterus clavicornis	11		
,, erythrocephalus	18	Cœlambus impressopunctatus	11		
Noterus sparsus	17	Hydroporus gyllenhalii	10		
Haliplus variegatus	10	Colymbetes fuscus	10		
Rhantus exoletus	10	Hydroporus lineatus	10		
Ilybius obscurus	7	,, palustris	9		
,, ater	5	,, neglectus	8		
		Rhantus exoletus	7		
		Ilybius ater	6		
		Dytiscus punctulatus	6		
		Agabus bipustulatus	5		
		,, nebulosus	5		
		Haliplus obliquus	4		
		Hydroporus planus	2		
		Haliplus confinis	1		

From the table it will be seen that the same species are not as a rule dominant in each list. 27 species show a plus value with *H. pictus*, 34 with *H. granularis*, and 19 with *H. gyllenhalii*. Sixteen out of the 27 species in the "Pictus" column appear in the "Granularis" column, while only three are common to the "Pictus" and "Gyllenhalii" lists. On the other hand, 16 species are common to "Granularis" and "Gyllenhalii." This suggests that the group of species usually associated with *H. granularis* may occur mixed with the group usually associated with *H. pictus* and also that the "granularis" and "gyllenhalii" groups may occur mixed. The "Pictus" and "Gyllenhalii" groups are however quite distinct, presumably indicating a different normal habitat of the species of the two groups. That the "granularis" group should occur mixed with both the other groups suggests that it is capable of division into two groups, one towards "pictus" the other towards "gyllenhalii," or perhaps that the "granularis" group has a wider range than either of the others. However, as I have said, my object in referring to this part of the subject was to acquaint you with the method, and that I have endeavoured to do. No doubt further observations will modify some of the figures attached to the species in the above table, as some, such as *Cœlambus versicolor* and *Cnemidotus impressus* have not occurred in sufficient collections to make their exalted positions assured. No doubt when more of the groups are worked out cross references such as "A" in "B" collections and "B" in "A" collections will also modify some of the values, but on the whole I believe the method is sound and will yield positive results.

I have now endeavoured to give you a resumé of the main facts which have appeared in the course of systematically collecting the Water Beetles of the Broads district. I have noted many other facts than those to which I have referred, but I am not at present in a position to interpret them, and without interpretation facts are often very trivial things.

I hope, however, in the course of time to be able to make more complete statements on the various points upon which I have touched, and to be able to add a few sound facts to our knowledge of the subject of bionomics.

VII.

THE *HYDRACHNIDS* OF THE NORFOLK BROADS.

By Chas. D. Soar, F.R.M.S.

(Communicated by Mr. F. Balfour Browne, M.A., F.R.S.E.)

Read 28th February, 1905.

Believing the Norfolk Broads to be a good and prolific collecting ground for "Fresh Water Mites," I spent a few days in the autumn of 1898 and the Easter of 1899 in that district with some Quekett friends who were also interested in Microscopic pond life but in different forms. I found a large number of specimens; but I was a little disappointed at the smallness of the number of species found, which only amounted to about thirty in all. Potter Heigham was the centre at which we stopped, going out in a different direction every day. By this means we left very little water round Potter Heigham unexplored. The temperature in the district was very low, both in the autumn and spring, which might partly account for the paucity of species found, for no doubt the delicate species betake themselves to the deep water in cold weather, a habit which renders them inaccessible to the collector. I think I should have obtained much better results if I had again visited the district during the summer, but the opportunity never occurred. However, although I could not get to the Broads, the Broads in a way came to me. Mr. Balfour Browne, the Director of the Sutton Broad

Biological Laboratory, has during the last year kept me well supplied with mites preserved in formalin, with records of dates and localities. These mites have all had my attention as time allowed and the present list is the result. I call it simply a preliminary paper, because I believe a great many more species are yet to be found in a district so well adapted for fresh water life of all kinds, teeming as it is in all its waters with vegetable and animal forms.

In the British Isles at present we have about 150 species representing thirty-seven different genera. In this paper which represents the Norfolk Broads only, we have seventy-one species representing twenty-two genera. Two species only are new records for Britain, but there are about six species I have not yet been able to identify, and these may turn out something new. If so, they will be described in the next paper.

To judge by our present knowledge of the *Hydrachnidae*, their life-cycle appears to occupy about three years. This being so, there is every reason to suppose that another year's collecting would bring in several species which do not figure in this list. The eggs are generally deposited on the under side of the leaves of water plants, *Anacharis* being a favourite plant for that purpose. In some cases the eggs are found floating about in small batches near the bottom or on the mud, enveloped in a gelatinous film. All mites, I believe, are oviparous. The time the eggs take to develop varies with the genera, and no doubt is also much influenced by the temperature and environment to which they are subjected at the time, and eggs which have taken twenty days in a small glass tank in a warm room would, perhaps, take twenty-five in a lake. Those that I have watched develop at home have taken from twelve to thirty-nine days, according to the genera to which they belonged. For instance, *Piona* took twelve days, *Arrhenurus* twenty-four, *Eulais* thirty-eight, and *Limnesia* thirty-nine. The larvæ which hatch from the eggs are hexapod, and they soon become parasitic. No doubt each species has its own particular host which it seeks and to which it attaches itself as soon as possible. It is this

stage which at present we are most ignorant about, and it is this stage which the Biological Station on the Broads ought to be of great assistance in helping to clear up.

Mr. Balfour Browne has sent me during the year 1904 several hosts, such as *Corixa* and *Notonecta*, with larvæ of the Water mites attached, which have always turned out to be the larval forms of the genus *Hydrachna*. I have myself found on the Broads the parasitic mites *Atax Bonzi* and *Atax ypsilophorus* in the Fresh Water Mussel, and I have also found larval forms of *Arrhenurus* parasitic on a small fish; but what becomes of the larvæ of the other mites, such as *Limnesia*, *Piona*, *Diplodontus*, and others, has yet to be discovered.

Some have been found, I believe, in Fresh Water Snails (*Planorbis*). I have examined some hundreds of specimens of this mollusc, but so far have found nothing to record.

As far as we know, the larvæ remain attached to their host for about a year, during which time they grow very considerably. They ultimately throw off the six legs they started life with and hang like little pears upon the legs and body of the host. In the spring they break out of the envelope which encloses them and become free-swimming, with eight legs in the place of the six they first started with. This stage, in which they are known as *Nymphs*, lasts another twelve months and is spent in eating and growing. At the end of this time they pass into an inert or pupal stage from which they emerge adults. They are pale, thin, and weak at first, but they soon develop into the beautiful creatures they are in shape and colour when fully grown. How long they will continue to live when fully developed I cannot say, but I have kept some considerably over twelve months alive in a window tank.

The list herewith includes all collections made as far as I know since October 2nd, 1896, when a small collection was sent to me by a Quekett friend who had spent his holiday on the Broads.

Adult forms only have been examined, larvæ and Nymphs not having been considered for the purpose of this paper.

The nomenclature used is the same as used by Dr. Piersig in his account of all known Water Mites in Das Tierreich, Berlin, 1901.

The names given where found refer to the different parishes in the Broads district.

HYDRACHNIDÆ.

Genus I. ARRHENURUS.

All the members of this genus are hard skinned, with very bright colours. Reds, blues, greens, and yellows. The males very unlike the females.

1. A. albator, Müll. Not common. Potter Heigham, Wroxham.
2. A. bruzelli, Koen. Potter Heigham, Wroxham.
3. A. caudatus, Geer. Potter Heigham, Sutton, Wroxham, Barton, Horning.
4. A. claviger, Koen. Common. Potter Heigham, Sutton, Ranworth, Hickling, Ingham.
5. A. cordatus, Pier. Rare. Potter Heigham.
6. A. crassicaudatus, Kram. Potter Heigham, Ormesby, Rollesby.
7. A. compactus, Pier. Rare. Sutton.
8. A. forpicatus, Neuman. Rare. Sutton.
9. A. freemani, Halb. Sutton.
10. A. globator, Müll. Common. Catfield, Sutton, Ranworth, Potter Heigham, Wroxham.
11. A. leukarti, Pier. Rare. Sutton, Ranworth.
12. A. maculator, Müll. Fairly common. Catfield, Wroxham, Sutton, Hoveton St. John.
13. A. ornatus, George. Common in 1904. Sutton.
14. A. robustus, Koen. Rare. Catfield.
15. A. sinuator, Müll. Catfield, Sutton.
16. A. solidus, Pier. Ranworth, Wroxham.
17. A. tricuspidator, Müll. Sutton, Catfield.
18. A. tubulator, Müll. Common in 1904. Catfield, Sutton, Ranworth.
19. A. virens, Neuman. Ranworth, Hickling.

GENUS II. ATAX.

120. A. BONZI, Clap. Parasitic in Fresh Water Mussel. Potter Heigham.

121. A. CRASSIPES, Müll. Common. Free swimmer. Wroxham, Potter Heigham, Sutton. Two varieties; both found.

122. A. FIGURALIS, Koch. Rare. Potter Heigham.

123. A. INTERMEDIUS, Koen. Rare. Potter Heigham.

124. A. YPSILOPHIORUS, Bonz. Parasitic in Fresh Water Mussel. Potter Heigham.

GENUS III. ATRACTIDES.

125. A. SPINIPES, Koch. Rare. Potter Heigham.

GENUS IV. BRACHYPODA.

126. B. VERSICOLOR, Müll. A very small, brightly coloured Mite. Very common. Potter Heigham, Ormesby, Wroxham, Sutton.

GENUS V. DIPLODONTUS.

127. D. DESPICIENS, Müll. Common, everywhere on the Broads. Bright red.

GENUS VI. EULAIS.

128. E. GEORGEI, Soar. Potter Heigham, Hickling, Wroxham, Burgh St. Margaret.

129. E. MÜLLERI, Koen. Wroxham.

130. E. PROJECTUS, Soar. Catfield.

131. E. SOARI, Pier. Catfield.

Two other species of this genus not yet identified.

GENUS VII. FRONTIPODA.

132. F. MUSCULUS, Müll. Potter Heigham, Sutton, Two varieties of this Mite, red and green, both found on the Broads.

GENUS VIII. HYDRACHNA.

133. H. BIVIRGULATA, Pier. Rare. First record for Britain. Wroxham, April, 1904.

134. H. GLOBOSA, Geer. Common. Catfield, Wroxham, Ingham, Horsey.

35. H. PALUDOSA, Thon. Rare. Wroxham.
36. H. SCUTATA, Pier. Wroxham, Hickling, Catfield.
One species not at present identified.

GENUS IX. HYGROBATES.

37. H. LONGIPALPIS, Herm. Common. Potter Heigham, Catfield.
38. H. RETICULATUS, Kram. Potter Heigham.
39. H. TRIGONICUS, Koen. Rare. Ranworth.

GENUS X. HYDRYPHANTES.

40. H. DISPAR, Schaub. Wroxham.
41. H. HELVETICUS, Haller. Potter Heigham.
42. H. RUBER, Geer. Catfield, Ingham, Horsey.

GENUS XI. LAMINIPES.

43. L. ENSIFER, Koen. Catfield.
44. L. ORNATUS, Koch. Hickling.

GENUS XII. LIMNESIA.

45. L. HISTRIONICA, Herm. Common everywhere on the Broads.
46. L. KOENIKEI, Pier. Ormesby.
47. L. MACULATA, Müll. Wroxham, Calthorpe, Hickling, Sutton, Catfield.
48. L. UNDULATA, Müll. Catfield, Sutton.

GENUS XIII. LIMNOCHARES.

49. L. AQUATICUS, Latr. Potter Heigham, Ingham, Acle.

GENUS XIV. MIDEA.

50. M. ORBICULATA, Müll. Horning, Potter Heigham, Sutton.

GENUS XV. MIDEOPSIS.

51. M. ORBICULARIS, Müll. Potter Heigham.

GENUS XVI. NEUMANIA.

52. N. SPINIPES, Müll. Potter Heigham, Ingham.
53. N. VERNALIS, Müll. Sutton.
One species not identified.

GENUS XVII. OXUS.

54. O. STRIGATUS, Müll. Ormesby. One species not identified.

GENUS XVIII. PIONA.

There is a question if this genus should be known as *Piona*, nearly all the writers now calling it *Curvipes*, but as I am using Piersig's nomenclature I will use the name.

55. P. AMBIGUA, Pier. Catfield, Sutton.
56. P. ADUNCOPALPIS, Pier. Common in the Broads in 1904. Catfield.
57. P. CONTROVERSIOSA, Pier. Common in 1904. Catfield, Horning, Ingham. First record for Britain.
58. P. CARNEUS, Koch. Potter Heigham, Stalham, Salhouse, Wroxham.
59. P. CONGLOBATA, Koch. Burgh St. Margaret.
60. P. FUSCATA, Herm. Burgh St. Margaret, Catfield, Sutton.
61. P. LONGIPALPIS, Kren. Potter Heigham, Catfield.
62. P. NODATA, Müll. Potter Heigham.
63. P. OBTURBANS, Pier. Burgh St. Margaret, Catfield.
64. P. RUFA, Koch. Sutton, Potter Heigham.
65. P. ROTUNDA, Kram. Sutton.
66. P. UNCATA, Koen. Burgh St. Margaret, Catfield, Horning.

GENUS XIX. PIONACERCUS.

67. P. VATRAX, Bar. and Mon. Potter Heigham.

GENUS XX. PIONOPSIS.

68. P. LUTESCENS, Herm. Potter Heigham, Sutton, Catfield.

GENUS XXI. SPERCHON.

69. S. SQUAMOSUS, Kram. Ranworth.

GENUS XXII. THYAS.

70. T. LONGIROSTRIS, Pier. Ranworth, Catfield, Hickling.
71. T. VENUSTA, Koch. Wroxham, Salhouse.

One species not identified.[4]

VIII.

METEOROLOGICAL NOTES, 1904.

(From observations taken at Bradestone House, Brundall, Norfolk.)

By Arthur W. Preston, F. R. Met. Soc.

Read 28th February, 1905.

January.

Dampness and dulness, which had been the prevailing meteorological characteristics of the earlier part of the winter, continued throughout this month, which, beyond some slight morning frosts, gave but few winterly traits. For the seventh January in succession the mean temperature was above the average, although less so than in 1902 and 1903. Frequent barometric depressions passed over the country during the first half of the month, but an anticyclone, with maxima of about 30.70 ins., prevailed in the third week. Rain fell on twenty days to a total of less than the average, but no snow was recorded.

February.

Down to the 22nd day the barometer continued in a very low state, and there were frequent depressions, accompanied by heavy rains. It was the wettest February in this vicinity since 1881. South-westerly winds generally prevailed, and gales occurred on the 12th, 13th, and 21st. The last week was winterly, with snowstorms, but the frost was not very severe.

March.

The month was a good average one, both rainfall and temperature being in close agreement with normal conditions. There was but little barometric variation until the last week,

when, on the 28th, a sudden and rapid fall set in, the mercury falling over an inch in 36 hours. There was but little snow. The east winds in the third week assisted in drying the surface of the soil, which had been in an exceedingly wet and sloppy state for a long time previous, owing to the frequent rains of the winter. Vegetation started about a month later than in the previous year. Thunder occurred on the 8th and 29th.

April.

This was one of the finest and most beautiful Aprils experienced for many years past. Mean temperature was as much as 3 degrees above the average (being 6 degrees higher than in the previous April), and on no day throughout the month did the thermometer fail to touch 50 degrees, a circumstance which, as far as can be ascertained, had not happened since the very warm April of 1865. Rainfall was only half the average, and the absence of rain was not unwelcome after the many months of downpour and dampness which had previously prevailed. There was but little easterly wind, and the show of fruit blossom was most abundant.

May.

The barometer was generally at a fairly high elevation, and there were no depressions of note. The weather was, on many days, very bright and cheering, and, on the whole, it was a much better May than usual. Mean temperature was 1.6 above the average, and the amount of rain about normal. There was but little east wind, and the blossoming of the orchards proceeded almost without a check.

June.

Although there was no great heat, this was a very fine month, with many pleasant summer days. There was considerable keenness in the air on some of the earlier days of the month. The total rainfall was only ·68 ins., and, following a dry April and May, the want of moisture by the end of

the month was much felt. The haymaking proceeded with but little interruption, and garden fruits ripened early.

July.

This was a very fine and hot month, the thermometer reaching 86.8 on the 15th (which was a higher July reading than had occurred since 1900), and it exceeded 80 degrees on six other days. There was no rain whatever between the 3rd and the 19th, and the drought was severely felt. During the last week a highly electrical state of atmosphere prevailed, and the weather broke into heavy thunderstorms, with tropical downpours in places. As is usual in such cases, however, the storms were exceedingly partial. The chief falls at Brundall were .60 ins. on the 25th, .52 ins. on the 26th, and .22 ins. on the 27th, and the accompanying thunder was severe. The storm of the 27th was more severely felt at Norwich, where it lasted for nearly two hours continuously, the electrical outbursts being exceedingly violent. The western side of the city had the worst of the visitation, and at Keswick no less than 2.65 ins. of rain fell during the storm.

August.

Continued great heat prevailed during the first week, the reading of the thermometer on the 4th (87.6) being in excess of any of the July readings. A cooler period followed, but the weather continued generally fine till the 17th. The third week was somewhat rainy, with exceedingly low day temperatures for the season, maxima of but little over 60 degrees being recorded for several days in succession. Considerable thunderstorms, particularly on the evenings of the 21st and 22nd, occurred during this period, but in the last week there were many lovely days of nearly cloudless sunshine.

September.

The chief characteristic of this month was the absence of really warm days, with no very cold nights. During the earlier part of the month there were some days of a rough

and chilly character, but during the latter half there was much sunshine, although sometimes accompanied by morning and evening fogs. Mean temperature was 1.2 below the average, and the thermometer only exceeded 70 degrees on one day.

October.

This was a very fine month, with almost cloudless sunshine on many days. Following so splendid a summer this was more than could have been expected, and a rainy autumn would have surprised nobody. Mean temperature was 1.8 above the average, and the rainfall less than half the usual October total. On some days there were morning and evening fogs, and there was an unusually sharp frost, for so early in the season, on the morning of the 15th, the screened thermometer falling to 29.4.

November.

Down to the 21st great mildness prevailed, the temperature exceeding 50 degrees daily. The latter part of this period was, however, accompanied by wet fogs, which made atmospheric conditions somewhat uncomfortable. An abrupt change to mid-winter occurred on the 21st. The mean temperature of the week ending the 28th was as low as 32.6 degrees, or more than 11 degrees below the November average, and on the 24th the screened thermometer fell to 23 degrees, which is the lowest November reading since 1890. Heavy falls of snow occurred, accompanied by gales and rough winds from the west and north-west, and the country was enveloped in a white mantle more like January than November. The amount of snow and intensity of frost here were, however, much less than in places in the Midlands and North of England, where the amount of snow was sufficient to impede railway traffic.

December.

The first fortnight was very rainy and unsettled, over two inches of rain being registered by the 15th. A large anticyclone in the third week, which enveloped the whole

country, and which was accompanied by readings of the barometer of remarkable uniformity over the entire kingdom, caused dense fogs of a character not known in this part of England for many years. These fogs caused much interruption to traffic and business in the week before Christmas. Much dampness and gloom prevailed during the Christmas holidays, and a sudden fall of the mercury on the morning of the 30th brought a violent gale, doing much damage in all directions. It had the effect, however, of dispersing the fogs, and gave place to more seasonable meteorological conditions at the close of the month.

The Seasons.

The following tables show the mean temperature and rainfall of the four seasons, together with those of the five previous years, compared with the usual averages. Winter comprises the three months December to February inclusive, Spring, March to May; Summer, June to August; and Autumn, September to November.

TEMPERATURE.

Seasons.	1899.	1900.	1901.	1902.	1903.	1904.	20-year average 1883-02.	Departure of 1904 from average.
	degrees.	degrees.	degrees.	degrees.	degrees.	degrees.	degrees.	degrees.
Winter ...	42.6	37.4	39.0	37.9	41.8	38.3	38.0	+0.3
Spring ...	46.2	45.3	46.3	46.3	47.3	47.8	46.3	+1.5
Summer ...	61.9	61.6	61.4	58.7	58.7	60.8	60.3	+0.5
Autumn ..	51.2	51.6	50.7	50.1	51.2	49.8	50.2	−0.4
Year ...	49.8	49.6	48.8	48.4	49.5	49.3	48.7	+0.6

RAINFALL.

Seasons.	1899.	1900.	1901.	1902.	1903.	1904.	38-year average 1865-02.	Departure of 1904 from average.
	in.	in.	in.	in.	in.	in.	in.	in.
Winter ..	5.82	7.42	5.88	6.09	3.64	5.96	5.96	0.00
Spring ...	6.84	4.26	5.10	6.77	5.83	4.59	5.27	−0.68
Summer ...	3.52	8.77	3.61	7.82	10.54	4.70	6.94	−2.24
Autumn ...	8.31	5.32	5.11	4.14	9.77	4.98	8.01	−3.03
Year ...	23.94	26.99	21.06	22.30	29.44	21.50	26.18	−4.68

The above tables show that the mean temperature was a little over average in the winter, considerably above in the spring (higher than since 1896), slightly above in summer, and slightly below in autumn. The rainfall in winter agreed exactly with the normal fall, in spring it was slightly below, in summer it was two and a quarter inches deficient (though less so than in the summer of 1901), the fall of the quarter being less than half that of the previous summer quarter. In the autumn the deficiency exceeded three inches.

The Year.

The dreary, damp weather which had characterized the last six months of 1903, continued till the end of February, the last-named month having been the wettest of the year. With March a new state of things set in, and a fine, growing spring gave place to a magnificent summer and a warm, pleasant autumn. A fine show of fruit blossom in the spring had but little bad weather to check it, with the result that both summer and autumn fruits were prolific and well matured. The mean temperature of each of the months, except June, September, and November, was up to or above the average, and there was a deficiency of rainfall in each of the months of April to November inclusive, resulting in a falling off of the year's rainfall to as much as 4.68 ins. below the mean. A marked feature was the absence of any very heavy falls of rain on any one day, the highest noted (.60 ins. on July 25th) having been the lowest year's maximum recorded here since these observations began, but this fact applies only locally, for as above stated, over two and a half inches of rain occurred at Keswick (Norfolk) in a single thunderstorm on July 27th, the fringe only of which extended to Brundall. Wheat-cutting commenced about August 3rd, and harvest was concluded before the close of the month. The abnormal fogs of December were an unpleasant feature at the conclusion of the year.

1904.

Month.	Barometer. Highest.	Date.	Lowest.	Date.	Mean.	Thermometer. Highest.	Date.	Lowest.	Date.	Mean.	Hydrometer. Mean Relative Humidity. 9 a.m.	Cloud. Estimated Proportion	Rainfall. Inches.	No. of Days.	Wind. Direction. N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Mean estimated force
	in.		in.		in.	°		°		°	%												
Jan.	30.69	22	28.89	14	29.945	55.0	13	23.2	23	38.3	91	7.3	1.51	20	3	0	2	6	6	6	7	1	2.8
Feb.	30.30	28	28.61	9	29.574	55.0	21	26.2	28	38.9	88	7.8	3.17	24	1	3	6	2	3	4	8	2	3.6
March	30.36	24	29.29	30	29.982	60.0	19	24.2	12	40.8	88	7.5	1.93	19	1	10	7	0	3	4	4	2	3.6
April	30.25	18	29.44	13	29.913	68.6	15	32.8	22	49.3	74	6.2	.86	11	1	1	3	3	1	3	6	12	3.9
May	30.28	20	29.46	7	29.951	75.2	26	34.8	10	53.2	78	6.9	1.80	13	2	2	3	4	3	2	8	7	3.2
June	30.34	22	29.43	25	30.051	75.6	14	39.8	13	56.6	73	6.9	.68	9	2	6	3	2	5	2	5	5	3.1
July	30.34	18	29.63	26	30.042	86.8	15	46.2	4	64.4	76	4.8	1.85	9	1	2	6	1	1	5	11	4	2.1
Aug.	30.23	28	29.59	17	30.004	87.6	4	42.0	21	61.3	77	5.5	2.17	13	3	1	0	5	3	4	9	6	3.0
Sept.	30.39	18	29.70	14	30.090	72.0	5	38.0	26, 30	56.2	80	5.5	1.78	11	0	5	6	4	2	5	3	5	2.8
Oct.	30.51	13	29.43	5	30.098	66.2	19	29.4	16	51.1	88	6.7	1.20	13	4	1	4	5	4	2	4	7	2.4
Nov.	30.59	14	29.23	22	29.975	59.0	9	23.0	24	42.2	92	7.3	2.00	15	3	2	0	2	3	0	12	8	2 9
Dec.	30.63	19	28.92	12	29.918	56.0	16	21.0	22	39.4	94	7.3	2.55	23	2	0	0	2	3	4	10	10	2.4
Means					29.962					49.3	83	6.6											3 0
Extreme & Totals.	30.69	Jan. 22nd.	28.61	Feb 9th.		87.6	Aug. 4th.	21.0	Dec 22nd.				21.50	180	23	33	40	36	37	41	87	69	

IX.

NOTES ON THE HERRING FISHERY OF 1904.

By T. J. Wigg.

Honorary Secretary Great Yarmouth Section.

Read 28th March, 1905.

"Away to the East at the dawn of day,
The boats sail out o'er the sleeping bay;
The clanging of chains and the creak of oar
Are echoed back to the silent shore.
Father, protect them through the night,
And bring them home in the morning light."—*Moir.*

What can be said of the Herring Fishery that has not been said before? What new light can be thrown on this harvest of the sea?

The autumn fishing of 1904 opened somewhat later than for some years past, and the outlook for the first week or two was anything but satisfactory. Taking into consideration, however, the fact that there are thousands of boats (both steam and sailing) ever after the Herrings from January to December, the wonder is that there are any Herrings left at all, unless we may assume that they are of separate families off different parts of the coast of our islands. Fortunately this fish is wonderfully prolific, and multiplies exceedingly, so that each annual fishing finds the much sought for "dainties" in never ceasing millions, and the boats sail or steam away in increasing numbers year by year to gather them in.

The vicinity of the fish wharf at Yarmouth was again this year the scene of great bustle, and presented a most animated appearance. Thousands upon thousands of barrels have been landed from vessels and stacked near the troughs on the breezy Denes. Great complaints were again made concerning the muddy plots where the women and men had to stand all day long. No shelter was provided for the women, who were obliged to work in the open during all changes of weather, unless the day was very wet, when all out-door work was suspended. There appears to be quite a diversity of opinion concerning the unsheltered outdoor work of the Scotch girls and women. Some of the employers characterise the work as a summer occupation, and say that the girls are used to out-door employment, that in stormy weather boats do not venture out to sea, and consequently there is no fish at hand to prepare; but they think that the women work too many hours per day while at Yarmouth.

The women do not object to out-door work, but would prefer some shelter from wind and rain, and would also like a more solid foundation upon which they could stand, instead of being inches deep in mud and filth, as is the case now, owing to the defective drainage. So far as I could ascertain this appears to be the only real ground of complaint, as their overtime is irregular, and does not amount to much in the course of the season. A good spurt of work is needed when fish are plentiful to make up for time wasted in waiting when there is only a small supply of Herrings. I notice that Mr. Broadhurst, M.P., visited Yarmouth during the last fishing, and made a good deal of talk about the anæmic appearance of the fisher girls, and the strong fishy smell of the place. I quite agree with the latter part of his remark; but with that portion dealing with the physique of the Scotch women or girls I totally disagree. To my mind they are, on the whole, as healthy a class of women as can be found anywhere, and Mr. Broadhurst's remarks may be classed as nonsense.

During the height of the fishing season a great deal of friction was caused between Scotch buyers and the Yarmouth

Corporation by the way a public auction was conducted for the purpose of letting the fishery plots for the year. The auction room was crowded with Scots and other curers, and the auctioneer was asked to name the reserve price on each plot offered for competition. This was not given, but the sale proceeded, and a few plots were let in the usual way. One plot not realising expectations was withdrawn. The curers dissented, and in the end the majority of those present left the room and thus boycotted the letting for a time. Rightly or wrongly, the Scotchmen at Yarmouth were under the impression that they were not fairly treated by the Corporation, and they made no secret of their grievances. A correspondent to the *Eastern Daily Press* charges the Wharf Committee with the old standing grievance of favouring local fishermen to the detriment of Scottish fishers. He says :—" It is no uncommon thing to see a Scotch boat with a cargo of perishable goods lying astern of an English boat whose stem is at the quay and nothing to do. Again it is claimed that at times the English boat may have nets or salt to take on board and therefore he must lie. On the other hand, and we do not object if the custom is universal, the Scotch boat has to move away from the discharging berth immediately his cargo is delivered, and he is not allowed even the necessary time to fill his water-tanks, which would mean at the utmost from five minutes to fifteen minutes." The charges are either true or untrue, but they are certainly not new. Fortunately the matter was partially arranged as the result of a deputation to the Fish Wharf Committee. The ultimate result of the above was the formation of an Association called the Yarmouth Scottish Fish Traders' Association, to have for its object the mutual benefit of all branches of the industry.

At the annual dinner in connection with the Great Yarmouth Fish Trade, one of the Scottish curers, Mr. Slater, quoted a set of striking figures, which may be interesting as showing the value of the Scottish community to Yarmouth during the Herring season. " Scottish curers," he said, " dealt with Herrings to the extent of about £300,000 each season. Over

100 curers, ship-brokers, and commission agents came to Yarmouth, and they brought down 400 coopers and 1,800 women. 450 Scottish boats had come, and 240,000 barrels of Herrings were packed. For food and lodging, carting, and in the purchase of presents no less than £31,500 was spent in Yarmouth. In dues on salt and Herring boats £10,000 was paid to the local authorities."—*The Fish Trades Gazette.*

Although at times the trade was not at all brisk, yet when the end of the season came it was found that after all the fishing had not been so bad as some of the merchants prophesied, and most of the curers and Herring agents were fairly well satisfied with the season on the whole. As will be seen by the figures at the end of these notes the total catch was slightly in excess of that of last year. In the 470 Scotch steam and sail boats there were some 3,760 men, while the 183 steam and sail craft with about 1,800 men belong to this port. During the month of November 114,500 barrels of pickled Herrings were exported to the ports of Northern Europe.

During the past season the Fisher Girls' Rest, under the able superintendence of Miss Davidson, has been of great service to the 2,000 Scotch women and girls. At the little surgery of the Institute nearly 1,300 wounded hands and fingers were dressed, and this help has been greatly appreciated by all.

Lowestoft Herring Voyage.

Speaking generally, the season has been a long way below the Lowestoft average, and is in fact the worst which has been known at the port for six or seven years. The Scotch fleet, consisting of many less boats than last year, managed to make a very good season. Lowestoft boats, both sailing and steam, have had, on the other hand, a very poor time.

"The bad season will, undoubtedly, affect the labour market in Lowestoft. There are usually large stocks of cured Herrings in the town at the end of the season, and numbers of hands are employed in dealing with them. This year, however,

the stocks are very low, and many workers are already paid off who would otherwise have found employment for some weeks after Christmas. The export trade in both fresh and pickled Herrings has shown a substantial increase. These Herrings are required for immediate consumption, and it is not so essential that they should be of the best quality."—*Eastern Daily Press*, December 24th, 1904.

Mr. W. L. Smith, the Yarmouth Borough Accountant, and Mr. H. J. Henderson, the harbour master of Lowestoft, have again kindly given me particulars of the Herrings landed at the respective ports.

RETURNS OF HERRINGS LANDED AT YARMOUTH IN 1904.

Month.	Lasts.	Month.	Lasts.
January	10	Brought forward	313
February		July	87
March	20	August	890
April	69	September	1,076
May	37	October	18,548
June	177	November	15,063
		December	3,184
Carried forward	313	Total	40,961

Number of Yarmouth boats employed, about . . 183
,, Scotch and other boats employed, about 470

RETURN OF HERRINGS LANDED AT LOWESTOFT IN 1904.

Month.	Lasts.	Month.	Lasts.
January		Brought forward	911
February	—	July	76
March	95	August	38
April	438	September	136
May	174	October	11,778
June	204	November	11,552
		December	2,683
Carried forward	911	Total	27,174

Number of Lowestoft boats employed . . . 232
,, Scotch boats employed . . . 291

X.

ON *BAGOUS LUTOSUS*, GYLL., IN NORFOLK; WITH SOME COLLATERAL MATTER.

By James Edwards, F.E.S.

Read 28th March, 1905.

In his paper entitled "The Coleoptera of Norfolk and Suffolk,"* Mr. Claude Morley, F.E.S., etc., has divers notes and observations on certain species of beetles recorded by myself as occurring in this County. The tendency of these notes and observations is to discredit the general accuracy of the Society's List of Norfolk Coleoptera † and the competence of its compiler; consequently I think it well to offer the following remarks in explanation.

I should add that this information was quite at the service of the publishing authority of the Society before Mr. Morley's paper was printed; and, further, that I had no opportunity of seeing his statements in which I am interested, until the paper was in circulation.

Carabus clathratus. The opinion that this insect is "extremely doubtfully English" is by no means peculiar to Mr. Newbery; indeed, as much might be gathered from my notice of it (*antea* vol. v. p. 433).

Cardiophorus ruficollis, Cardiophorus thoracicus, and Goniocteña affinis. The capture of these species by present-day collectors is not recorded, but the application to them of the term "interlopers" appears to serve no useful purpose.

* *Antea* Vol. VII., pp. 706–721.

† *Antea* Vol., V. pp. 427—508; Vol. VI., pp. 512—527.

LIMNICHUS PYGMÆUS. Mr. Morley's reference to this species does not indicate either an additional locality or a widening range. The insect was already recorded as common in a few spots on the cliffs at Cromer (*antea* vol. vi. p. 519).

BYTHINUS BULBIFER I found to be the commonest species of its genus in Norfolk, and I had already noted it as locally abundant.

ANOMALA FRISCHII is a common sand-hill species; there is consequently nothing remarkable in the finding of its pupa on the Winterton sand-hills.

CEUTHORRHYNCHUS PICITARSIS, BLEDIUS PALLIPES, COLENIS DENTIPES, and APION PUBESCENS, found by Mr. Elliman at Cromer. I did omit from my List: the two former because they were omitted by Mr. Elliman himself from what purported to be a complete list of his captures in this County furnished by him to me in 1898; and the two latter because they are not included in the last named list nor in that given in the Entomologist's Record, vol. vii. p. 306, neither were they otherwise notified to me.

AGRILUS VIRIDIS. Mr. Morley says that the *Agrilus viridis* of my List is certainly *Agrilus angustulus*, Ill. I had already noted the probability that Burrell's *viridis* was really *angustulus*; but unless the material on which Burrell's record was based has been found and identified, it is difficult to see where the certainty comes in. I believe that Burrell died in 1825, and my own efforts to ascertain what had become of his collections met with no success whatever.

LEPTURA SANGUINOLENTA. Whether the records for this species are "most unsatisfactory" or not is necessarily a matter of opinion; but with regard to the statement that "no authentic British specimen is known to exist," it may be well to point out that Fowler (Col. Brit.

Islands, vol. iv. p. 237) records one specimen taken by Mr. Champion at Aviemore, Moray District, Scotland. Perhaps Mr. Morley satisfied himself that this specimen no longer exists, or that Champion's determination of the species was erroneous!

THYAMIS RUTILUS. There can be no objection to Mr. Morley suspecting the Norfolk specimens to be the red form of *T. jacobeæ*; but when he says that "*T. rutilus* is confined to the south coast of England," one can only conclude that he intends to question Champion's determination of the specimens taken by J. J. Walker at Halstow near Chatham.

PLECTROSCELIS SAHLBERGI. There was not the slightest occasion to indicate any doubt concerning the occurrence of this species in Norfolk. It can only be mistaken for *P. subcærulea*, and Mr. Morley may be surprised to learn that in determining the specimen of *P. Sahlbergi* which I took at Honing in July, 1887, I used for comparison specimens of the former given to me thirty years ago by the late E. C. Rye.

BAGOUS LUTOSUS. With regard to this species Mr. Morley says, "the above record refers to some other species." This is not a fact, and, from the nature of the case, Mr. Morley can have no justification whatever for such a statement. He never saw, nor did he, so far as I know, ever try to see, the specimen upon which my record was based; yet he does not hesitate to say that it is wrongly determined! Some time since I wrote to Mr. Morley asking him to be good enough to say to what species my record *did* refer; at the same time drawing his attention to the fact that his prescience had already enabled him to say that the record referred to some species other than that which

I recorded, and pointing out that, as he had never seen the specimen in question, his dictum on either point must be equally trustworthy. I am still waiting for his reply.

Stephens many years ago gave "Norfolk" as a locality for this species; it has remained in our text-books of British Coleoptera ever since, and I had no difficulty in identifying it by means of the characters there laid down. Champion (Ent. Mo. Mag. vol. xxxiv. p. 52, March, 1898) says that he had not seen a specimen in any British Collection. Newbery (Ent. Rec. vol. xiv. pp. 149–156. June, 1902) says that his investigations had led him to the conclusion that no authentic British specimen of *B. lutosus* was to be found, and he omits the species from his otherwise excellent "Revision of the British Species of Bagous." He says that he had been induced to attempt the latter task from having all the British forms in his possession; from which it would appear that what he had not seen wasn't British—for him. Under these circumstances I thought it well to reinvestigate the material on which my Norfolk record was based, and by the kindness of Mr. Champion I had an opportunity of comparing my insect with an authentic Swedish example of *B. lutosus* from the collection of Dr. C. G. Thomson, of the University Zoological Museum, Lund, said to have come from Gyllenhal himself. Finding that the two insects agreed in their essential characters I took occasion to point out (Ent. Mo. Mag. vol. xxxviii. p. 240. October, 1902, nearly a year and a half before Mr. Morley's paper was read) that, Champion and Newbery notwithstanding, I certainly had one Norfolk specimen of the species in question. Since

then Mr. Thouless has found amongst his West Norfolk material four specimens of this rarity, and two of these, with my one, were exhibited at the meeting of the Entomological Society of London, held on the 2nd November, 1904, where their determination was not questioned by any of the Coleopterists present. *Sine ira !*

[Mr. Claude Morley having perused the above, requests the insertion of the following reply to Mr. Edwards' remarks.—Ed.]

Through the courtesy of the Journal Committee, I have been allowed the pleasure of perusing an advance copy of the above paper, and am much gratified that my little article there referred to should have elicited such interesting and useful details upon some of the rarest of Norfolk's beetles. To call forth discredit upon the List or its Compiler was not thought of and is quite out of the question; but where discussion was deemed necessary possibly doubtful records were instanced, I trust in a manner *la plus sincère et la plus courtoise*. The *Limnichus*, *Bythinus*, and *Anomala* were mere personal captures, for which nothing remarkable was claimed. It is very satisfactory to learn that *Plectroscelis sahlbergi* is correct. Concerning *Bagous lutosus*, Gyll., no more need be said; I was wrong, and my error arose from the fact that I overlooked the confirmation of this species as British (E.M.M. 1902, p. 240). It is, however, extremely improbable that any one would have the temerity to question the authenticity of so closely allied a form during a Meeting of the Ent. Soc., especially as this species and *Bagous glabrirostris*, Hbst., are both very variable and the variation runs upon somewhat parallel lines—close microscopic examination would be indispensable to a reliable determination. With respect to the *Leptura*, I should perhaps have substituted the word

"English" in place of "British," since the only authentic records appear to be Mr. Champion's two captures of this species in the pine forests at Aviemore in 1876 and 1892. *Thyamis rutilus* has been taken on *Scrophularia* at Halstow, which is near Chatham by Walker, at Southsea by Moncreaff, and at Swanage by Champion, who says, "It is probably confined to the neighbourhood of the South Coast."

I may perhaps be permitted to add the following species to the "List of Norfolk Coleoptera":—*Dyschirius salinus* at Wells and Sherringham, *Tachys scutellaris* with *Bledius arenarius* and *B. bicornis* at Wells, *Scymnus ater* at Holt, *Heterocerus femoralis* and *H. britannicus* at Cley, and *Dorcatoma flavicornis* at Barton Broad. These were all captured in August, 1904, and kindly communicated to me by Dr. Norman H. Joy, M.R.C.S., L.R.C.P.

XI.

SOME ADDITIONS TO THE NORWICH CASTLE-MUSEUM IN 1904.

By Frank Leney.

Read 28th March, 1905.

Of the additions to the Castle-Museum collections of Natural History which may be deemed of special interest is a well-mounted specimen of the rare Addra Gazelle (*Gazella ruficollis*) shot in Western Kordofan by the donor, Mr. Edward North Buxton, and heads of Beisa Antelope (*Oryx beisa*), and the Sabre-horned Antelope (*Oryx leucoryx*), a species remarkable for the exceedingly fine point to which the horns taper.

Another notable addition is that of a head of the almost

extinct American Bison (*Bison americanus*) from Wyoming. The head is that of a grand old bull, and Mr. Lydekker considers it to be of the typical prairie race. This specimen is admirably mounted by Rowland Ward, from whom it was purchased by the Castle-Museum Committee. The United States National Museum also presented a weathered skull of the Bison from Montana, U.S.A., which has been placed with the Osteological collection.

Other additions to the animals are a Wild Cat (*Felis catus*), trapped in Invernesshire, in 1903, and presented by Mr. A. Heneage Cocks ; a Garden Dormouse (*Myoxus quercinus*) from Wimereux, Boulogne, presented by Mr. E. P. Larken, through Mr. J. H. Gurney, and a pale variety of the Mole (*Talpa europæa*), taken at Shimpling, Norfolk, by the Rev. J. W. Millard.

To Engineer Lieut. R. W. Skelton, R.N., of the " Discovery," are due the thanks of all Norfolk Naturalists for his generous donation to the Museum of a collection of birds obtained by him during the time the " Discovery " was in the Antarctic regions. Included in Lieut. Skelton's gift is an adult female specimen of the Emperor Penguin (*Aptenodytes forsteri*), and a " chick " from the " rookery," discovered by the donor on sea-ice near Cape Crozier, Victoria Land ; the only rookery so far discovered. The other skins are those of the King Penguin (*A. patagonica*) ; Adelia Penguin (*Pygoscelis adeliæ*) ; Snowy Petrel (*Pagadroma nivea*) ; Cinereous Petrel (*Priofinus cinereus*) ; Silver Grey Petrel (*Priocella glacialoides*) ; Antarctic Petrel (*Thalassæca antarctica*) ; Antarctic Skua (*Megalestris antarctica*) ; and a Black eye-browed Albatros (*Diomedea melanophrys*).

Other interesting additions to the birds are a White Heron (*Herodias egretta*) from Brazil, presented by Mrs. Hancox ; a Giant Crane, or "Native Companion" (*Antigone australasiana*) from Australia, by Mr. Harold Wilson ; Jungle Fowl, or Wild Cock (*Gallus sonnerati*) from India, by Sir William Lee-Warner; a collection of thirty birds from Natal, obtained for the late Dr. R. J. Mann when in the colony, presented by Mrs. Mann ; and nestlings of Nightjar (*Caprimulgus europæus*), from

Harperley, and Gannet (*Sula bassana*) from the Bass Rock, Mr. W. H. Bidwell.

The Museum Committee also acquired by purchase, the Sooty Tern (*Sterna fuliginosa*) which was picked up dead on Santon Downham Heath in the early part of April, 1900, by Mr. J. Nunn, of Little Lodge Farm, Santon Downham; described by Mr. W. G. Clarke in Trans. N. & N. Nat. Soc., vol. vii. (1903), p. 752.

Mr. J. H. Gurney presented thirteen skins of North American Sparrows, including eleven species, and had the rare pleasure of adding one new species to the Raptorial Collection in addition to a New Guinea Hawk-Eagle, and three Indian Eggs. Mr. Gurney has kindly sent me the following notes on the additions to the Birds of Prey :—

"As the Norwich Museum contained only one example of the fine *Harpyopsis novæ-guineæ*, Salva., obtained many years ago by my father, who looked upon it as a prize at that time, the Curator was not sorry to acquire another. It had been collected by Mr. H. Pratt, in August, 1903, in British New Guinea (Babooni, 3,000 feet). My father looked upon Harpyopsis as not far removed from Thrasætus, the great Harpy of South America, being like it a bare-legged Hawk-Eagle, but it is probably a bird of more active habits. The chief Raptorial addition during the year, and the most important for some time, is the fine South American *Leucopternis princeps*, Scl : from Boquese Chiriqui (height 3,500 feet) in N.W. Ecuador. This, with other birds, was obtained by one of Mr. Rosenberg's successful collectors, some of whose consignments formed the subject of an article in Novitates Zool : (vol. ix. p. 599), by Mr. Hartert. The Norwich Museum has now the whole of the genus Leucopternis except *L. occidentalis*. The dispersion of Mr. K. C. Macdonald's collection of Indian eggs at Mr. Stevens' sale-rooms gave an opportunity of filling up a few more gaps among our disiderata in Raptorial Oology. Authenticated examples were secured accordingly of *Gyps himalayensis*, *Gyps tenuirostris*, (2) ; and *Gyps pallescens* (from Col. Rattray)."

Mr. Eustace Gurney presented a glazed mahogany case

containing models of birds painted to illustrate the manner in which wild animals are commonly hidden. These models were skilfully coloured by Mr. E. S. Goodrich, after those prepared by Mr. Abbot H. Thayer, of Scarbro', N.Y.

The British Oological series has been enriched by Mr. L. W. Leader, who gave ninety eggs, including eighteen species, mostly taken in Norfolk ; Mr. Thomas Southwell also presented eggs of the Rough-legged Buzzard (*Archibuteo lagopus*) from Lapland, and White-tailed Eagle (*Haliætus albicilla*) from Shetland.

To the British Reptiles was added a Ringed Snake (*Tropidonotus natrix*), killed on Hall Road, Norwich, in July, 1904, presented by Mr. E. J. Scarlett.

An important event in the history of the Museum was the Conference of the Museums Association held under the presidency of Dr. S. F. Harmer, F.R.S., in the Museum buildings, during July 11th to 15th, 1904. This Congress was attended by representatives from the Museums of Christiania, Trondhjem, Sydney, and Boston, U.S.A., as well as Liverpool, Manchester, and most of the important Museums in this country.

During the twelve months ending December 31st, 1904, the number of visitors to the Museum was 113,905.

XII.

NATURAL HISTORY NOTES FROM YARMOUTH.

By A. H. Patterson.

Read 28th March, 1905.

1904.

March 17th, 1904. A fine female example of the Masked Crab (*Corystes cassivelaunus*) was brought to me from a shrimp-boat.

On March 19th, a small, and somewhat dilapidated fish came into my hands, having been netted that day by a shrimper. It was in spawn. I believed it to be a Montagu's Sucker (*L. montagui*), and forwarded it to Mr. T. Southwell, who expressed the same opinion. On the 28th, my shrimper friend, who had been on the alert, brought me another, also a female, and full of ova. Length 2½ inches. This proved satisfactorily to be *L. montagui*, and new to my Yarmouth list. *L. montagui* spawns in March and April, its relative spawning in January and February. It is most abundant in summer, taken both in draw and shrimp-nets; and is usually found gorged with the common Shrimp.

March 26th. Visited the Breydon watcher in his ark. Jary handed me his note book, wherein I found he had seen 200 Wigeon drop in on a N.E. wind on March 11th. On the 14th, hundreds of Dunlins arrived accompanied by some Redshanks. A day or two later "thousands of Dunlins and Ringed Plovers" were noted. Wind W.N.W. with fine rain. On the 24th, some Pintail Ducks. Wind N.E. strong.

On March 28th, the first example of the Smooth Hermit Crab (*Paguris lævis*), I have met with here, was taken in a shrimp-net ; it was inhabiting the shell of *Murex erinaceus*.

Six Brent Geese for a number of days in March frequented Breydon ; I saw them there on the 26th. They remained until the middle of April (last seen on 16th).

April 8th. I observed a number of Dunlins still as grey as in the depth of winter.

April 14th. A $2\frac{7}{8}$ inch Rock Goby (*Gobius niger*) taken by a shrimper. Another April 20th.

April 19th. A Twait Shad (*Clupea finta*) taken, with ten spots on each side,

April 19th. A solitary Spoonbill on Breydon. Wind N.N.E. Contrary to my usual experience, and his own, I observed that the Gulls mobbed him continually, and allowed him very little rest. The first appearance of a stranger is apt, however, to make these birds restless and inquisitive, not to say quarrelsome.

On April 20th, several Gasteropods of the order *Nudibranchiata* were brought me by a shrimper, I believed them to be *Æolidia papillosa*. With them were several examples of the Little Squid.

April 23rd. Eleven Wigeon still on Breydon. A Plaice, 13 inches in length, came into my hands, whose dorsal and anal fins completed a half circle by running below and joining under the tail.

April 25th. Another female Montagu's Sucker taken.

A fine example of the Bellows—or Trumpet-fish—reached me on April 28th, from Milford Haven, through a fish merchant then located in that vicinity. It measured $7\frac{1}{4}$ inches from the tip of the snout to the tip of the tail. It has been placed in Yarmouth Museum. As yet this species is not recorded for the Norfolk Coast.

May 11th. Seven Spoonbills on Breydon. Also two Avocets, and a few Lesser Terns.

May 16th. Two Angler-fish (*Lophius piscatorius*) taken in shrimp-nets.

On June 7th two interesting fishes turned up, viz. :—a

northerly wind, and opened in a fan-shaped sweep, dropping for a rest on the muds, but were gone next day.

A few Lesser Terns had been seen on Breydon on August 1st, where for three or four years past they have shown up in increasing numbers. In August, Herring-syle is usually abundant in the river and in the channels and drains of Breydon; this year there was a singular scarcity of this fry, which is their favourite food on the east coast: from this cause, no doubt, scarcely any Terns visited the locality. "No Syle, no Terns," seems to be the order of things, just as in a weir "no mackerel-midge—no salmon." There was a singular scarcity of Jelly-fishes, and the various high-swimming crustaceans, *e.g.*, *Idotea tricuspidata* and *I. linearis*, that are in summer usually so abundant.

August 15th. An eighteen-inch Grey Mullet flung itself out of the river into the ferry-boat, to the great surprise of a solitary passenger and the ferryman. This occurred at dusk.

August 21st. "The night alive with Curlews and other rain-wearied birds" (Note-book).

On August 29th, I was asked to go and see a young Cuckoo, that had been reared from a nest; it was fed on small slices of raw beef. The bird survived the following winter, and as recently as March 27th (1905) I saw the same bird, still alive, but in a rather ragged condition, in apparently good health, in the bar of a public-house in the town. It was content with a diet of beef, and bread, and milk, in which *a few bird seeds* were mixed. It is rather surprising that such a bird should live in the atmosphere of a bar; and equally so on such a rough and ready diet!

The young northern-bred waders dropping into Breydon, usually bring to my mind Cowper's lines applied to Robinson Crusoe's companions:—

> "They are so unacquainted with man,
> Their tameness is shocking to me."

This indifference to the human form was strikingly evidenced on September 10th, when a Curlew-Sandpiper flew in from seaward, alighted on a flat not six feet from my punt, and

straightway put its bill under wing-coverts and fell fast asleep. I disturbed it once or twice by shifting my boat a few feet and hallooing, but it only took pains to keep a low stump between it and myself, and persisted in falling asleep after moving a few inches. On the 15th a number of young Dunlins refused to take wing, and would only run when half-an-oar's length from the bow of my boat. No wonder Dunlins, Knots, and other wading birds of the year—the advance guard of the migrating flocks—suffer so at the hands of gunners content with unsportsmanlike methods and small game.

September 18th. A young live Guillemot was brought to me at my house-boat, having been picked up by a lad on a rond. The primaries were not even showing, and the bird had certainly never flown; it was exhausted, very dirty, and had in all probability floated from the Yorkshire coast on a heavy tide, and come up with the flood to Breydon.

A marked influx of Kingfishers was noticed on the same date.

September 25th. A Heron, high in the air, just at sundown passed over my head on the North Denes flying seaward, and due east. I followed it with my glasses until it faded out of sight.

Lapland Bunting taken the day before (September 24th). Subsequently a few others.

In September I saw two common Collared Doves that had been caged 12 and 25 years respectively. They were in excellent condition.

On October 10th, a very beautiful Gasteropod, *Aplysia punctata*, was sent me from Cromer by the Rev. H. C. Fitch.

On October 13th, a Dabchick was shown me at the Fish-wharf, which had been brought in from sea on a fishing-lugger, against whose galley the poor little thing had struck in an erratic attempt at flight across seas. The vessel was fishing forty miles out at the time.

On the same afternoon, as I was going to the Wharf, a Woodcock struck a telegraph wire near Beeching's dock, and fell on the road, where it was picked up with the upper part of the skull so badly cut that only a piece of skin held it. A

very similar accident occurred to another, the breast being also cut to the bone, early in December.

October 19th. Great Grey Shrike shot at Belton. On the same date I observed many half-putrid Herrings washed up by a "driving" tide. An inshoring tide had washed these ashore, with a great quantity of broken seaweeds. Many hundreds of various Gulls lined the shore, or floated lazily beyond the breakers, gorged with their feast.

October 28th. A friend, by no means well versed in ornithology, described to me a bird, without a shadow of doubt, a Hoopoe, that his son, a golf attendant at Caister, had shot on the links, and given to his ferrets, last spring.

November. During a north-west gale early in November, a great number of Lapwings came over. On the 12th many were brought into the market. It is a curious fact, which I have before noticed, that large migratory flocks usually arrive on an adverse wind, and invariably land very tired, and with apparently laboured flight.

Brent Geese, which seem to be much rarer here than in years gone by, were in some numbers heading south in the middle of November. Some Swans were seen, and a great addition to the various Ducks was noted in the neighbourhood.

November 17th. A full-grown Herring was handed to me on whose back was a huge swelling, which Mr. Southwell described as an encysted hydatid tumour. This is an unusual thing in Herrings. All the parts in its neighbourhood were much congested, and the tumour contained watery fluid.

On November 23rd, a "Bull-dog" variety of the Cod, 10 lbs. in weight, was caught.

December, an exceedingly blank month.

XIII.

FAUNA AND FLORA OF NORFOLK.

Lichens of Norfolk and Suffolk.

By Rev. E. N. Bloomfield, M.A.

Read 28th February, 1905.

For some years past I have endeavoured to bring together all that is known of the Cryptogams occurring in these two counties, that thus there may be the means of a more complete enumeration at some future time should any one think it worth while to take up the subject.

At the beginning of the last century there were a good number of Botanists residing in Norfolk and Suffolk who assiduously collected these plants, among them the best known were Mr. Dawson Turner, Sir James E. Smith, and Sir William Hooker, all residing in Norfolk. Before this time, however, many Cryptogams had been observed by Sir John Cullum of Hawstead, near Bury, and recorded by him in his journal, which, however, I have not seen and hence cannot quote. There were afterwards several good botanists residing in Suffolk, as the Rev. G. R. Leathes, Sir Thomas Gage, Mr. Woodward, etc. Many of their observations are published in English Botany, The Botanist's Guide, etc. Mr. F. K. Eagle, of Bury, also diligently collected Mosses and Lichens, principally in Suffolk. His collection is incorporated with that of Sir C. Bunbury, who was also a collector, and whose Herbarium is now in the University Botanical Museum at Cambridge.

In 1860 was published Messrs. Henslow and Skepper's Flora of Suffolk, which contains lists of the Cryptogams, doubtless imperfect, but still good and dependable. The lists of the Mosses and Lichens were, I believe, in a great measure by Mr. Eagle and Mr. D. Stock of Bungay. After the publication of the Flora, Mr. Skepper devoted much time to verifying the records contained in it, and in so doing added a good number of species to the list. I have specimens and manuscript notes from him, and have myself published lists of the Mosses and Hepatics of Suffolk in the 'Journal of Botany' in 1885 and 1888, and subsequently of the Mosses of Suffolk and the Hepatics of Norfolk in our Transactions for 1900–1901, and 1903–1904.

I would now do the same for the Lichens of these two counties. Most of the localities recorded are given by Leighton in his 'Lichen Flora of Great Britain,' and where he had himself seen the specimen he marks them ! which, therefore, I have copied ; he also records the date of the introduction of each species to the British Flora and gives the name of the person who first detected it. Many of these species were introduced from Norfolk or Suffolk specimens by Norfolk or Suffolk botanists ; where this is the case I also give the name and the date ; the majority of these are due to Mr. Dawson Turner, and others to Sir James Smith, etc. This fact should, I think, give Norfolk botanists an interest in the list even if they do not study the Cryptogams. A good many additions were made later by Mr. Larbalestier, who in his 'Lichen Herbarium' has included a good number of specimens from Norfolk and Suffolk. In the Victoria History of Norfolk, Mr. Crombie has given a capital list of Norfolk Lichens to which, however, I can make a good number of additions both in species and localities.

No corresponding recent list exists for Suffolk. I think, therefore, it may not be amiss to print a list for the two counties, and the more so as no notice of the Lichens has appeared in our Transactions. Another reason for a combined list is that many of the species are recorded in a way which does not distinguish between the two counties, for such a record as this

"Near Yarmouth" may be in either or both counties, there is, therefore, a manifest advantage in combining the lists.

The Abbreviations are as follows:—

C. B. Sir C. Bunbury, Bart., of Barton Hall, Author of Botanical Fragments, &c.—specimens in his Herbarium.

Crombie. List of Lichens in the Victoria History of Norfolk.

E. N. B. The Rev. E. N. Bloomfield, Guestling, Sussex, and Great Glemham, Suffolk.

Engl. Bot. English Botany and Supplement, 1790—1849.

Eagle. Specimens and Information given by him to Mr. E. Skepper.

Fl. Flora of Suffolk, Henslow and Skepper, 1860.

O. B. G. Old Botanists' Guide, 1805.

Larb. Larbalestier's Lichen Herbarium.

G. R. L. The Rev. G. R. Leathes, Bury St. Edmunds.

Lich. Brit. Lichenographia Britannica, Turner and Borrer, 1839.

Sir J. E. Smith. Author of English Flora, &c., &c.

E. S. Mr. E. Skepper, Bury St. Edmunds.

D. T. Mr. Dawson Turner, F.R.S., Yarmouth.

Hist. Yar. Sketch of the Natural History of Yarmouth, by C. J. & J. Paget, 1834. The List of Lichens is by Mr. Dawson Turner.

The numbers are those of the vice-counties, 25 East Suffolk, 26 West Suffolk, 27 East Norfolk, 28 West Norfolk.

Thetford Warren is in Suffolk.

The nomenclature and arrangement are those of Leighton's 'Lichen Flora of Great Britain.'

COLLEMACEI.

COLLEMEI.

COLLEMA CONFERTUM, Ach. Yarmouth, D. T., 1810.

,, ? FURVUM (granulatum), Ach. 26. Walls of Horringer and Troston Churches, E. S. Groton and Barton, C. B.

,, PULPOSUM (cristatum) Bernh. Common, Hist. Yarmouth. 26. On the ground about Bury, E. S.

,, ,, var. TENAX, Ach. 27. Old walls Runton and Cromer, Larb.

,, LIMOSUM, Ach. 26. Westley and Brandon, C.B.

COLLEMA CRISPUM, Huds. Common, Hist. Yar. 26. Frequent about Bury. Thurston, C. B. 27. Old walls by the sea, Runton, Larb.

,, CHEILEUM, Ach. 28. Old walls at Thetford, Larb.

,, FLACCIDUM, Ach, 26. Honington on tomb and Stowlangtoft, E. S.

,, NIGRESCENS, Huds. Common, Hist. Yar. 25. Near Bungay, Woodward. Swefling, E. N. B. 26. Near Bury, Eagle.

LEPTOGIUM MICROPHYLLUM, Ach. 26. On Elm bark, Bury. G. R. L., 1810. Engl. Bot. Hardwick Heath, C. B.

,, TENUISSUNUM, Dicks. 25. About Bungay, Woodward. Burgh, Belton, &c., D. T., O. B. G. 27. Sandy bank near Norwich, Mr. Crowe, 1782. Ditchingham, Coltishall, &c., O.B.G.

,, CRETACEUM, Sm. In Chalk pits. 26. Wangford, E. Bury, E. S. Thetford, C. B.

,, LACERUM, Ach. Common, Hist. Yar. 26. Honington churchyard wall. Barnham, on walls, E. S.

,, ,, var. PULVINATUM, Hoffm. 27. Old mossy walls about Cromer, Larb.

,, SUBTILE, Schrad. 25. Lound. Belton, &c., D. T. Near Harleston. D.T., O. B. G. 26. Bury, E. S. Hardwick heath, C. B. 27. Coltishall, &c., D. T., Engl. Bot.

,, SINUATUM, Huds. 25. Abundant on ruined walls, Burgh Castle, D. T., Engl. Bot. 27. Old walls, Thorpe, Norwich, D. T., O. B. G.

,, PALMATUM, Huds. 25. Sand hills, Corton, &c., Hist. Yar. 27. Yarmouth Denes and sand hills at Hemsby, D. T., O. B. G.

,, TURGIDUM, Ach. 25. Gorleston Church and Dunwich, D. T.

,, SCHRADERI, Bernh. Not uncommon, Hist. Yar. 28. Heaths near Bury, D. T., E., and E. S. 27. Caistor Church, D. T., Engl. Bot.

LEPTOGIUM MUSCICOLUM, Sw. 27. Among moss on Hemsby sand hills, D. T., O. B. G.

LICHENACEI.

CALICIEI.

SPHINCTRINA TURBINATA, Pers. Common. Hist. Yar. Frequent Fl. 25. Great Glemham, E. N. B. 26. Hardwick, E. S.

ANGLICA, Nyl. 27. Caistor, on Oak rails, Borrer, 1805. Engl. Bot.

CALICIUM CHRYSOCEPHALUM, Ach. 25. Park pales at Sotterley, D. T., 1804. Engl. Bot. 27. On old wood at Framingham Earl. Lich. Brit.

,, PHŒOCEPHALUM, Borr. 25. Barn at Bruisyard, D. T., O. B. G. Chediston. Kirby Trimmer. 27. Barn, Lakenham, D. T., 1805, O. B. G.

,, ACICULARE, Sm. (chlorellum). 26. Near Bury on Scotch firs, G. R. L., 1812. Engl. Bot. Hardwick, E. S.

,, TRICHIALE var. STEMOMEUM, Ach (æruginosum) 26. Old pales near Bury, G. R. L., Lich. Brit. Bardwell.

,, var. FERRUGINEUM, Borr. 25. Rumburgh, Kirby Trimmer. 26. Old pales about Bury, G. R. L., Lich. Brit. 27. Framingham Earl, on pales, D. T., 1839. Lich. Brit.

,, HYPERELLUM, Ach. 26. Oaks near Bury, G. R. L. Livermere and Ickworth. Lich. Brit. 27. Earsham, Sir J. Smith, 1783. Engl. Bot. Acle, Borrer. Lich. Brit.

,, TRACHELINUM, Ach. (sphærocephalum). 26. In the hollow trunks of old Willows near Bury, G. R. L., Lich. Brit. Drinkstone, C. B. 27. Earsham, Crombie.

,, ,, var. XYLONELLUM, Nyl. 27. Framingham, Crombie.

CALICIUM QUERCINUM, Pers. (clavellum). Very common on posts, Hist. Yar. 26. Timber at Bury, E. S. Mildenhall, C. B. 27. Lakenham, on a barn, Borrer, 1805. Engl. Bot.

,, CURTUM, Borr. Common, Hist. Yar. 25. Great Glemham, E. N. B. 26. About Bury, Fl.

,, SUBTILE, Pers. (debile). Common, Hist. Yar. Mr. Skepper had specimens probably from Mr. Eagle. On old timber; frequently under the eaves of thatched buildings. Lich. Brit.

CONIOCYBE FURFURACEA, Ach. 25. Near Halesworth, Borrer, Lich. Brit. 26. Near Bury, G. R. L., 1805 Engl. Bot. Saxham, on trunk of Willow, E. S. and Larb. 28. North Wootton, Crombie.

TRACHYLIA TIGILLARIS, Fr. 25. Pales at Southtown, Yarmouth, D. T. Herringfleet, G. R. L., Lich. Brit. Little Glemham Park on a fallen Oak, E. N. B. Felixstow, Larb.

,, TYMPANELLA, Fr. 25 and 27. Common on gate posts about Yarmouth, D. T., 1800. O. B. G, 25. Halesworth, &c. 26. Ickworth, &c. 27. Earsham.

BÆOMYCEI.

BÆOMYCES RUFUS, D. C. Common, Hist. Yar. 26. Tuddenham, E. S. Rougham, C. B. 27. Near Norwich, Crombie.

,, ROSEUS, Pers. Heaths occasionally, Fl. 26. Thetford Warren, Crombie.

,, ICHMADOPHILUS, Ehrh. 26. Heaths about Bury, Fl.

CLADONIEI.

PYCNOTHELIA PAPILLARIA, Duf. 25. Lound and Belton heaths, D. T., O. B. G. Somerleyton, Kirby Trimmer. 26. Brandon, C. B. 27. Mousehold Heath, Sir. J. Smith, Engl. Bot.

Cawston and Stratton Strawless Heaths, D. T., O. B. G.

CLADONIA ENDIVIEFOLIA, Fr. 26. Abundant on Mildenhall Warren and in the plantations, C. B. 27. Very fine on sand hills Hemsby, Engl. F., Hist. Yar.

,, PUNGENS, Flk. 26. Brandon, C. B. 28. Thetford! Sir W. Hooker, Leighton.

,, CERVICORNIS, Schær. 26. Tuddenham.

,, CARIOSA, Flk. 25. Lound Heath, D. T., Engl. Bot. Barham Heath. 26. Santon Downham and Barton Mills. E. S. Mildenhall, C. B.

,, DELICATA, Flk. (parasitica). 25. Barham, and 27 Holt Wood! Engl. Bot.

,, ALCICORNIS, Flk. 25. Aldeburgh! Sir T. Gage. Lound Heath. 26. Hengrave, Sir T. Gage. Tuddenham, Icklingham, and Santon Downham, E. S. 28. Hunstanton, Crombie.

,, PYXIDATA, Fr. Common.

,, ,, var. CHLOROPHŒA, Flk. 28. Wootton Common, Crombie.

,, ,, var. FIMBRIATA, Hoffm. Near Yarmouth, Hist. Yar. 26. Santon Downham, E. S.

,, GRACILIS var. CHORDALIS, Ach. 25. Somerleyton, Kirby Trimmer. 26. Tuddenham and Santon Downham, E. S. Mildenhall Warren, C. B. 28. Sandy heath, Wootton Common, Larb.

,, DEGENERANS, var. ANOMŒA, Ach. 27. Lakenham, D. T., Engl. Bot.

,, FURCATA, Hoffm. Heaths frequent, Hist. Yar. 27. Lound Heath, D. T. 26. Mildenhall Warren, C. B. Brandon, &c.

,, CORNUCOPIOIDES, Fr. (coccifera). Common Hist. Yar. 26. Tuddenham, Rougham, &c. Fl. Norfolk, Crombie.

,, DIGITATA, var. MACILENTA, Hoffm. 26. Tuddenham. 27. Edgefield! Sir W. Hooker, Leighton.

CLADINA SYLVATICA, Hoffm. 25. Blaxhall Heath, E. N. B. 26. Tuddenham. 28. North Wootton Common, Larb.

,, RANGIFERINA, Hoffm. Heaths common.

,, UNCIALIS, Hoffm. Very common, Hist. Yar. 25. Belton, E. S. 26. Tuddenham and Santon Downham, E. S. Mildenhall, C. B.

STEREOCAULEI.

STEREOCAULON PASCHALE, Ach. 26. Mildenhall Warren, 1846, C. B.

USNEEI.

USNEA BARBATA, var. FLORIDA, L. 26. In fruit on Hengrave Park pales, G. R. L., O. B. G.

,, ,, var. HIRTA, L. Common on park pales and old trees.

,, ,, var. ARTICULATA, Ach. 26. Wangford Warren, C. B.

RAMALINEI.[1]

ALECTORIA JUBATA, L. 25. Sotterley and Worlingham park pales, D. T. and 26, Brettenham Park pales, G. R. L., O. B. G.

,, ,, var. CHALYBEIFORMIS, Ach. 26. Thetford Warren on the ground, Larb.

EVERNIA FURFURACEA, Maun. 26. Ampton Park pales, E. 27. Rails, Colby. Rev. H. Bryant. and pales at Kirby Bedon, G. R. L., O. B. G.

,, PRUNASTRI, L. Very common—In fruit. 25. Sotterley park pales, and 26, Hengrave Park pales, O. B. G. 27. Geldeston, O. B. G.

,, ,, var. STICTOCERA Ach. Mildenhall, on the ground, C. B.

RAMALINA CALICARIS, Hoffm. 27. Near Norwich, Crombie.

,, FARINACEA, L. Very common—In fruit, 25. Herringfleet Decoy, Gunton Wood, near Lowestoft, and Henham Park, D. T. 27. Heydon, Rev. H. Bryant, O. B. G.

Ramalina fraxinea, L. Common.

,, ,, var. ampliata, Ach. 26. Brandon, on old barn, Larb.

,, fastigiata, Pers. Common.

,, pollinaria, Ach. Common.

,, ,, var. humilis, Ach. Holt and near Norwich, E. M. Holmes.

Cetrariei.

Cetraria islandica, var. platyna. Ach. 28. Kings Lynn! Plowright, Leighton.

,, aculeata, Fr., var. muricata, Ach. 25. Lowestoft Denes, E. S. 26. Tuddenham, Rougham, &c., E. S. Mildenhall Warren, in fruit, C. B. 27. Yarmouth Denes, Hist. Yar. 28. North Wootton Common, Larb.

Platysma sepincola, Ehrh. 25. Worlingham Park pales, D. T.

,, ,, var. ulophylla, Ach. 27. Posts and rails by the sea, between Yarmouth and Caistor, D. T., Engl. Bot.

,, diffusum, Web. (aleurites). 25. Henham, Herringfleet and Sotterley Park pales, D. T. 26. Ickworth and Ampton, Eagle. In fruit near Bury, G. R. L., O. B. G. Euston Park, C. B. 27. Pound at Tofts Monks, Hist. Yar.

,, glaucum, L. 25. Corton and Sotterley, Fl. 26. Heaths about Bury. 27. Sall and near Sprowston, Crombie, specimen in British Museum. Norfolk, on old pales, Rev. H. Bryant. Engl. Bot.

,, juniperinum, var. pinastri, Scop. 27. Framingham, D. T., O. B. G.

Peltigerei.

Peltigera canina, L. Common.

,, rufescens, Hoffm. 25. Gorleston, &c., Hist. Yar. Lowestoft Denes, E. S.

PELTIGERA SPURIA, Ach. 25. Gorleston, &c., Hist. Yar. and Engl. Bot. 26. Mildenhall, C. B. 27. Near Norwich, Crombie.

,, POLYDACTYLA, Hoffm. 25. Gorleston, Hist. Yar. 26. Tuddenham, Cavenham Severals, E. S.

PARMELIEI.

STICTA PULMONARIA, Ach. 25. Easton and Parham, rare, Crabbe, O. B. G. Oaks in Barham Slade, Fl.

PARMELIA CAPERATA, L. 25. Shrubland Park, Little Glemham, &c. 26. Bury, Hardwick. 27. Caistor rails, &c., Hist. Yar.

,, OLIVACEA, L. Very common.

,, ,, var. EXASPERATA, Nyl. 27. Holt, Crombie.

,, PHYSODES, L. 25. Little Glemham Park pales, E. N. B. In fruit, Sotterley Park pales, D. T., O. B. G. 26. Santon Downham, &c., E. S.

,, PERLATA, L. Not uncommon.

,, TILIACEA, var. SCORTEA, Ach. 25. Melton and Framlingham, Fl. 26. Livermere ! G. R. L., 1809. Bury. 27. Lakenham.

,, BORRERI, Turn. 27. Norwich and Coltishall, D. T., Engl. Bot.

,, FULIGINOSA, Dub. Norfolk ! D. T.

,, CONSPERSA, Ehrh. 26. West Stow Heath, C. B.

,, ,, var. MOUGEOTII, Schær. 26. Thetford Warren, Larb.

,, ACETABULUM, Neck. (corrugata). 25. Rendham and Benhall, E. N. B. Near Bungay, Kirby Trimmer. 26. Ickworth Park, G. R. L. Engl. Bot. Lavenham, E. S. 28. Saham Wood, Sir J. Smith, 1799, Engl. Bot. Trees at Ashill, Sir J. Smith, O. B. G.

,, SAXATILIS, L. Common.

,, ,, var. SULCATA, Tayl. 27. Holt, in fruit, E. M. Holmes.

PHYSCIA PARIETINA, L. Common.

,, ,, var. AUREOLA, Ach. 28. Near King's Lynn, Larb.

,, ,, var. POLYCARPA, Ehrh. Near Yarmouth on rails and pales, D. T., 1807. Engl. Bot.

,, CILIARIS, L. Not uncommon.

,, PULVERULENTA, Schreb. Common.

,, ,, var. PITYREA, Ach. On trees and walls, common, Norfolk and Suffolk. 27. Strumpshaw, Sir J. Smith, Engl. Bot.

,, ,, var. SUBVENUSTA. 27. Norwich, Crombie.

,, OBSCURA, Ehrh. Trees about Yarmouth, D. T., O. B. G. 25. Swelling and Framlingham. 26. Hardwick and Tuddenham, &c., E. S. 27. Lakenham and Seething. Sir J. Smith, 1808. Trees at Caistor, &c., D. T.

,, ,, var. VIRELLA, Ach. 25. Trees about Yarmouth, D. T. and O. B. G. 26. Tuddenham. 27. Caistor, D. T., O. B. G.

,, ,, var. CLOTHRIX, Ach. 26. Kennet on poplar, Larb. 27. Old Willows at Coltishall, D. T., O. B. G.

,, ADGLUTINATA, Flk. (eleina) 27. Norwich, Sir J. Smith. Engl. Bot.

,, STELLARIS, L. and var. TENELLA, Scop. Common.

,, ,, var. CÆSIA, Hoffm. 25. Burgh, Bradwell, &c., D. T., Engl. Bot. 26. Hardwick and Icklingham, E. S. 27. Acle, D. T., Engl. Bot.

PANNARIEI.

PSOROMA HYPNORUM, Vahl. 25. Old bank on Lound Heath, D. T., O. B. G. 26. West Stow Heath, Eagle. 27. Hemsby Marrams, Hist. Yar.

PANNARIA PEZIZOIDES, var. CORONATA, Ach. Turfy ground near Yarmouth, Fl. 27. Hemsby, Hist. Yar. Guestwick, E. S. 28. Dry shady banks, North Wootton, Larb.

PANNARIA MICROPHYLLA, Sw. Yarmouth, D. T., Engl. Bot.

,, NEBULOSA. Hoffm. 28. North Wootton, Crombie, specimen in British Museum.

,, NIGRA, Huds. 25, Bradwell Church, D. T. 26. Cavenham, E. S. and Horringer Church walls, Fl. 28. Thetford, Crombie.

SQUAMARIEI.

SQUAMARIA LENTIGERA, Web. Chalky heaths, Suffolk, Engl. Fl. 26. Thetford Warren, Larb.

,, SAXICOLA, Poll. Near Yarmouth, Crombie. 26. Walls at Bury, E. S. On flints, Thetford Warren, Larb.

PLACODIUM MURORUM, Hoffm. Common. On roofs, &c.

,, DECIPIENS, Arn. 25. Herringfleet ! and Framlingham Castle ! D. T., Leighton. 26. Brandon, Eagle.

,, CITRINUM, Ach. Common, Hist. Yar. 26. Common near Bury, E. S. 27. Norwich, Crombie, brick and flint walls, Norfolk. Engl. Bot.

,, FULGENS, Sw. 26. Wangford, Eagle.

LECANOREI,

LECANORA VITELLINA, Ach. Common, Fl.

,, ,, var. CORUSCANS, Ach. 27. Palings near Cromer, Larb.

,, CANDELARIA, Ach. Rails and posts near Yarmouth. Engl. Bot. 26. Bury, E. S.

,, SQUAMULOSA, var. SMARAGDULA, Whlnb. 28. Thetford, on walls, Eagle.

,, FUSCATA, Schrad. 25. Gorleston ! Borrer, 1830. Engl. Bot.

,, TARTAREA, var. FRIGIDA, Ach. 27. Heaths near Norwich, Crombie.

,, UPSALIENSIS, L. 27. Causton Heath, H, Bryant, 1782, and Sprowston, D. T. and G. R. L., Engl. Bot.

LECANORA VARIA, Ehrh. 25. Halesworth, Flixton, &c., O. B. G. Burgh Castle, D. T., 1801. Engl. Bot. 26. Park pales at Culford, G. R. L. Tuddenham, E. S. 27. Between Yarmouth and Caistor, &c., D. T., O. B. G.

,, ATRA, Huds. Very common on walls.

,, CIRCINATA, Pers. 26. Bury, G. R. L., Engl. Bot.

,, SULPHUREA, Hoffm. Common. Hist. Yar. 25. Churchyard walls, Great Glemham and Rendham, E. N. B. 26. Old walls, Bury, E. S.

,, EXPALLENS, Ach. Common, Hist. Yar. 26. Thetford Warren, Larb. 28. Old trees and palings, Thetford, Larb.

,, LUTESCENS, D. C. (conizæa). Norfolk, on trees and pales, D. T., Engl. Bot. 27. Hevingham, E. B. t. 1136, Crombie.

,, SUBFUSCA, L. Very common.

,, ,, var. CAMPESTRIS, Nyl. Near Yarmouth, Crombie.

,, GALACTINA. Ach. 26. Bury, common on mortar, E. S.

,, HAGENI, Ach. 26. Brandon, on palings, Larb.

,, CALCAREA, var. HOFFMANNI, Ach. Suffolk. Engl. Bot. Churches near Yarmouth, Hist. Yar. 26. Lakenheath, Norfolk, Sir J. Smith.

,, GIBBOSA, var. PORINOIDEA, Flot. 26. Flints at Mildenhall, C. B. Thetford Warren. Larb.

,, PARELLA, L. 25. Great Glemham and Rendham churchyard walls, E. N. B. 26. Cavenham. E. S. 28. North Wootton, E. M. Holmes.

,, ,, var. TURNERI, Sm. 25. With shields. Sotterley, Belton. Fritton, and Herringfleet, O. B. G. 27. Gillingham and near Norwich, in fruit, D. T., O. B. G.

,, ALBELLA, Pers. 27. Holt. 28. North Wootton, E. M. Holmes.

,, AURANTIACA, var. SALICINA, Schrad. 27. Haddiscoe D. T., Engl. Bot.

LECANORA FERRUGINEA, Huds. (cinereo-fuscus). 26. Brettenham Park pales, G. R. L., O. B. G.

,, COLOBINA, Ach. On trees at entrance to Ickworth Park, Larb.

,, CERINA, Ehrh. 25. Bradwell, not uncommon about Yarmouth, D. T. 25. Herringfleet, G. R. L. 27. About Yarmouth and Coltishall, D. T., Engl. Bot.

,, PYRACEA, var. ULMICOLA, D. C. (luteoalba). 25. Sotterley Park, D. T., O. B. G. Great Glemham, E. N. B. 26. Links Wood, Rushbrooke, G. R. L., O. B. G. 27. Coltishall and Acle, D. T., O. B. G.

,, ,, var. HOLOCARPA, Ehrh. (atro-flava). 26. Bury, G. R. L., Engl. Bot. Thetford Warren, Crombie.

,, ,, var. PYRITHROMA, Ach. 26. Thetford Warren parasitic on the thallus of L. gibbosa, Larb.

,, ARENARIA, Pers. (caesio-rufa). 26. Abundant on walls at Bury, G. R. L., O. B. G. Tuddenham, Icklingham, &c., E. S. 27. Strumpshaw. Sir J. Smith, 1783, Engl. Bot. Scole Inn walls, D. T., O. B. G.

,, SOPHODES, Ach, 25. Old trees about Halesworth, frequent, D. T., O. B. G. About Yarmouth, D. T. Engl. Bot.

,, ,, var. EXIGUA, Ach. Old pales, Yarmouth, Hist. Yar. 26. Pales and bricks, Bury, E, S. 28. Walls, Thetford, Larb.

,, ,, var. ROBORIS, Duf. 26. Old trees at Tuddenham, Larb.

,, PYRENIOSPORA, Nyl. 26. Thetford Warren and Brandon, Larb.

,, HÆMATOMMA, Ehrh. 25. Gorleston, on walls, D. T., Engl. Bot. 26. Trees about Bury and Herringfleet, Fl. 27. Trees at Hevingham, O. B. G.

LECANORA CONRADI, Nyl. 26. Thetford Warren, Crombie.

,, UMBRINO-FUSCA, Nyl. 26. Thetford Warren, Crombie.

PERTUSARIEI.

PERTUSARIA DEALBATA, Ach. (I. coccodes). 25. Burgh Church and Flixton Park, D. T. 27. Forncett churchyard. Near Norwich on Oaks. Lich. Brit.

,, COMMUNIS, D. C. Very common.

,, FALLAX, Pers. (I. lutescens). 25. Bramfield Borrer 26. Ickworth Park Borrer. Lich. Brit. 27. Hevingham, Rev. J. Alderson. Acle Wood, D. T.

,, VELATA, Turn. (conspurcata). 25. Gorleston and other churches about Yarmouth, D. T., O. B. G. Henham, Wrentham, and Herringfleet, Borrer, Lich. Brit. Burgh Castle, D. T., Engl. Bot. 26. Ickworth Borrer. 27. Scole Inn, D. T. Cawston Church. Sir J. Smith. Engl. Bot. Hevingham church, Rev. J. Alderson, O. B. G.

,, FAGINEA, L. Common.

,, GLOBULIFERA, Turn. (discoidea). Near Yarmouth Borrer. Engl. Bot.

,, LEIOPLACA, Ach. Near Thetford, Crombie.

PHYLCTIS AGELÆA, Ach. About Yarmouth! D. T. 1807, Engl. Bot. 26. Risby, C. B.

,, ARGENA, Ach. Common, Hist. Yar.

THELOTREMEI.

THELOTREMA LEPADINUM, Ach. Not uncommon, Fl. 27. Costessey, Sir W. J. Hooker. Lich. Brit.

URCEOLARIA SCRUPOSA, L. Chalky heaths and brick walls, Norfolk and Suffolk. Engl. Bot. 25. Gorleston, &c., Hist. Yar. Rendham churchyard wall, E. N. B. 26. Walls at Bury and Fornham, E. S.

URCEOLARIA SCRUPOSA, var. BRYOPHILA, Ach. 25. Thetford Warren, on the ground among mosses, Larb.

LECIDEEI.

LECIDEA DECIPIENS, Ehrh. 26. Brandon, Eagle.

,, OSTREATA, Hoffm. (scalaris). 25. Halesworth and Sotterley—with Shields at Henham and Herringfleet, O. B. G. Little Glemham, on fallen Oak, E. N. B. 26. Fornham, Eagle. Mildenhall, C. B. 27. Toft, D. T., O. B. G.

,, DISPANSA, Nyl. 28. Thetford, on stones, Larb.

,, PROMINULA, Borr. 28. Thetford, Eagle and C. B.

,, FLEXUOSA, var. ÆRUGINOSA, Borr. 28. On roots of Pine, North Wootton, Larb.

,, DECOLORANS, Flk. (quadricolor). 25. Lound, D. T. Engl. Bot. Heaths at Ashby, Dunwich, and Herringfleet, O. B. G. 26. Tuddenham, E. S. 28. North Wootton, Larb.

,, ,, var. ESCHAROIDES, Ehrh. Near Yarmouth, D. T., Engl. Bot.

,, DUBIA, Borr. Common, Hist. Yar. 26. Bury, &c., on old boarded buildings, E. S. 27. Hevingham, Crombie. Norfolk, Borrer, 1813. Upon pales and boards, Sir J. Smith, Engl. Bot.

,, QUERNEA, Dicks. Common, Hist. Yar. 25. Benacre, E. S. Great Glemham, E. N. B. Norfolk, Dickson, 1785. Engl. Bot.

,, ENTEROLEUCA, Ach. 28. Thetford, Crombie.

,, PARASEMA, Ach. Common.

,, ,, var. ELÆOCHROMA, Ach. 27. Coltishall, Crombie.

,, ULIGINOSA, Schrad. Sandy heath near Yarmouth, D. T., 1799. Engl. Bot. 25. Bradwell and Lound, D. T., O. B. G. 26. Tuddenham, E. S. Rougham, C. B. 28. North Wootton, Larb.

LECIDEA COARCTATA, var. ELACHISTA, Ach. Brick walls about Yarmouth, frequent, D. T., 1798. Engl. Bot. 25. Gorleston Church, &c., Hist. Yar. 26. On walls, Bury, E. S.

,, CONTIGUA, Fr. 25. Gorleston churchyard, Gillingham, &c., D. T.

,, CANESCENS, Dicks. Very common—In fruit, 25. Benhall, E. N. B. 26. Barton and Bury.

,, MYRIOCARPA, D. C., var. CHLOROPOLIA, Fr. 25. Browston! and Halesworth! D. T. 26. Thetford Warren, Crombie. 28. Near King's Lynn, Crombie.

,, ,, var. PINICOLA, Ach. 26. Tuddenham and Bury. 28. Near King's Lynn, Larb.

,, ,, var. MUSCICOLA. 26. Tuddenham, on turfy bank, Larb.

,, GROSSA. Pers. 27. Cromer, E. M. Holmes

,, CÆRULEONIGRICANS, Lightf. 26. Wangford and Barrow, Fl. Lakenheath, Eagle. Thetford Warren, Larb. Norfolk, Woodward.

,, TRICOLOR, With. (Griffithii). Common on bark near Yarmouth, D. T., Engl. Bot. 25. On Bark Fritton and Ashby, Hist. Yar. 27. Trees near Cromer, Larb.

,, ,, var. INSIGNIS. 27. Runton, on palings, Larb.

,, CYRTELLA, Ach. Near Yarmouth, D. T., 1810. Engl. Bot.

,, EHRHARTIANA, Ach. 26. Livermere! and 27. Coltishall! Borrer. Barn door, Acle, D. T., 1803. Engl. Bot.

,, DILUTA, Pers. (pineti). 25. Bradwell and Somerleyton, Hist .Yar. 26. Tuddenham, E. S. Costessey, Sir W. J. Hooker, 1808. Leighton.

,, ALBOATRA, Hoffm. 25 and 27. Very common on trees round Yarmouth, D. T., O. B. G. 27. Seething, Sir J. Smith, 1808. Engl. Bot.

,, ,, var. EPIPOLIA. Ach. Common on walls. 28. Market Dereham Church, D. T., 1803.

LECIDEA AROMATICA, Sm. Near Yarmouth, D. T., 1807. Engl. Bot. 26. Vinefield walls, Bury, E. S. 28. Thetford, C. B.

„ TURNERI, Leight (candida). 27. Trigby Church! and Billockby Church, D. T., O. B. G.

„ MILLIARIA, Fr. var. SYNCOMISTA, Flk. 26. Thetford Warren, Larb.

„ SABULETORUM, Flk. 27. Norwich, Crombie.

„ PREMNEA, Ach. (abietina). 25. Hopton and Herringfleet, Hist. Yar. 26. Old Oaks at Bury, G. R. L., Engl. Bot.

„ RUBELLA, Ehrh. (porriginosus). 25. Elms at Hopton, D. T., O. B. G. 27. Elms at Caistor, D. T., 1801, O. B. G.

„ BACILLIFERA, Nyl. On decaying Bark, Brandon Park, Larb.

„ MUSCORUM, Sw. 26. Thetford Warren, Larb. 27. Buxton, D. T. Engl. Bot.

„ EFFUSA, Sm. 25. Old trees at Bradwell, D. T., O. B. G.

„ CUPULARIS, Ehrh. (marmoreus). 25. On Ash trees at Stoven, Fl. This was perhaps truncigera, Ach. 27. On Corpusty Church, Rev. H. Bryant, 1800. Engl. Bot.

„ EPIGÆA, Schr. 26. On sandy soil, Thetford Warren, Larb.

GRAPHIDEI.

OPEGRAPHA HERPETICA, Ach. 25. Bradwell! Borrer.

„ „ var. RUBELLA, Pers. Birch and other trees at Lound, &c., Hist. Yar. 25. Great Glemham, E. N. B.

„ „ var. RUFESCENS, Pers. Trees near Yarmouth, Hist. Yar.

„ ATRA, Pers. Smooth Bark, frequent.

„ TURNERI (betulina). Leight. Near Yarmouth on Birch Bark. Engl. Bot. 25. Bradwell! and Burgh! Borrer, Leighton.

OPEGRAPHA SAXICOLA, var. CHEVALLIERI, Leight. Suffolk! Sir T. Gage, Leighton. 25. Oulton Church, E. S. 27. Walls near Cromer, Larb.

,, VARIA, var. PULICARIS, Lightf. 27. Lakenham, Crombie.

,, ,, var. NOTHA, Ach. Old trees near Yarmouth D. T., 1808. Engl. Bot.

,, ,, var. TIGRINA, Ach. 27. Haddiscoe! Borrer, Leighton.

,, VULGATA, Ach. 25. Birch and other trees, Lound, &c., Hist. Yar. 26. Barton, C. B.

,, LEIGHTONII, Crombie (calcarea). Suffolk and Norfolk, Sir J. Smith.

,, LYNCEA, Sm. On old Oaks. 25. Between Bungay and Halesworth, D. T. Herringfleet Decoy, G. R. L., O. B. G. Great Glemham, E. N. B. 26. Ickworth Park. 27. Kimberley Park, Rev. J, Alderson. About Yarmouth, not uncommon, D. T., O. B. G. Holt, E. M. Holmes.

STIGMATIDIUM CRASSUM, Dub. 25. On Oaks, Great Glemham, E. N. B. 27. Holt, E. M. Holmes.

ARTHONIA SWARTZIANA, Ach. 26. Bury, E. S.

,, EPIPASTA, Ach. Near Yarmouth. D. T. 25. Lound, &c., Hist. Yar. 27. Thorpe, Sir. J. Smith, 1807. Eng. Bot.

,, CINNABARINA, Wallr. Common, Hist. Yar. Old walls, &c., frequent. Fl. 25. Great Glemham, E. N. B. 27. Earsham and Holt, Crombie.

,, PRUINOSA. Ach. (impolita). 25. Old Oaks near Halesworth and about Yarmouth abundantly, D. T., O. B. G. 26. Livermere! Borrer, 1831. Engl. Bot. 27. Old Oaks at Boughton, D. T. Barn at Lakenham, Mr. Crowe. O. B. G.

GRAPHIS SCRIPTA, Ach. Frequent Fl. Near Yarmouth, D. T., Engl. Bot. 25. Great Glemham. 27. Coltishall, Crombie.

GRAPHIS SCRIPTA, var. SERPENTINA, Ach. Near Yarmouth, D. T., Engl. Bot.

PYRENOCARPEI.

ENDOCARPON HEPATICUM, Ach. (Hedwigii). 26. Barrow Bottom, Fl. Norfolk, D. T., Engl. Bot. 27. Dry bank at Colby, Rev. H. Bryant, O. B. G.

VERRUCARIA EPIGÆA, Pers. (terrestris). 27. Norwich, G. R. L., 1806, Engl. Bot.

,, MAUROIDES, Schær. (umbrina). 25. Old walls and churches round Yarmouth, abundant, D. T., O. B. G. Gorleston Church! D. T. 1805, Engl. Fl. 27. Old walls about Yarmouth D. T., O. B. G.

,, NIGRESCENS, Pers. Old walls, common, Hist. Yar. 28. Thetford, Crombie.

,, FUSCELLA, Turn. Churches about Yarmouth, D. T., O. B. G. 25. Gorleston Church and Bradwell, D. T. 1805. Engl. Bot. and O. B. G. 26. Bury, E. S. 27. Redenhall church wall, J. T., O. B. G.

,, POLYSTICTA, Borr. Suffolk! G. R. L., Leighton. 26. Bury Vinefield walls, E. S. 27. Old walls near Cromer, Larb.

,, VIRIDULA, Schrad (tessellatus). Near Yarmouth, D. T., 1798. Engl. Bot. 25. Wall at Gorleston, D. T., O. B. G. 26. Bury, E. S. Lavenham, C. B. 27. Wall at Coltishall, D. T., O. B. G.

,, RUPESTRIS, Schrad, var. MURALIS. Old walls, common, Hist. Yar. 26. Bury, E. S. Lackford and Thetford, C. B.

,, CALCISEDA, D. C. 26. Bury, Larb.

,, GEMMATA, Ach. Trees, frequent. E. S. 26. Barton, E. S. Near Bury. C. B.

,, NITIDA, Weig. Generally on ash, common, Hist. Yar. Frequent. 25. Great Glemham, E. N. B. Woodbridge, C. B.

VERRUCARIA GAROVAGLII, Mnt. (sorediata). 28. On mud walls at Thetford, D. T. 1809. Engl. Bot.

,, INCRUSTANS, Nyl. 28. Crevices of old walls, Thetford, Larb.

STRIGULA BABINGTONII, Berk. 26. Cockfield on Laurel, Ch. Babington and Larb.

XIV.

FAUNA AND FLORA OF NORFOLK.

ROTIFERA.

BY REV. R. FREEMAN.

Read 28th *February*, 1905.

DURING a very busy year for me, I have had but small opportunity to turn my attention to this study.

But finding an opportunity at last I availed myself of the enterprise and courtesy of Eustace Gurney, Esq., and went down to the Norfolk Biological Station at Sutton Broad, on November 7th, and stayed there for four days, from the 7th to the 11th, and for two more days, the 15th and 16th November. I took with me a special travelling microscope, made by Swift, to pack in an extra small space. The box containing it and all accessories will all go into one side of a small Gladstone bag. This microscope is binocular, with triple nose, fitted with Abbe condensor with spot disc arrangement, etc., for dark background.

The object lenses used are 2-inch for searching, 1-inch for concentration on a special specimen, and $\frac{1}{5}$-inch apochromatic for identification of species after isolation.

My method of working is with the tube of microscope and also the stage, tilted at an angle of about 45° which allows the use of a thin glass tank 3″ by 2″ by $\frac{1}{4}$″, into which the weed and water to be examined is put. Then a binocular

search with the 2-inch objective gives one an idea of what is in the catch.

When a suspicious individual appears in the field, the 1-inch can easily be turned on, and if that does not allow of a positive determination of species, the individual is caught with a very fine pipette and transferred to a Rousselet compressor. The old-fashioned live box is an entirely useless contrivance compared with Mr. Rousselet's neat invention.

Under the gentle pressure of the micrometer screw of the compressor, the Rotifer is so nipped that she cannot move, yet not enough to injure her beauty. Then the $\frac{1}{5}$-inch object lens is adjusted or preferably a highly magnifying *eye piece*, inserted when the detail of jaws, antennæ, etc., are made clear and the species can then be correctly determined.

Should it be necessary to preserve the specimen, a very difficult operation follows. A weak solution of eucaine is added a drop at a time, and the animal is narcotised. As soon as she becomes placid and almost motionless, a drop of weak solution of osmic acid is then added and as quickly as possible removed again. Then frequent washings in formalin, and finally a stronger solution of formalin is put with the animal on to a slide previously ringed with gum damar and shellac, dissolved in gold size.

A careful adjustment of the cover slip is required to expel any bubble from the formalin and when the ring and cover is dry the slide can be stored as any other slide.

I have had eight years' continuous study of the Rotifers, and so most of them are now old acquaintances of mine, but one or two gave me a little trouble. These I sent off in a little tube of formalin to my great friend and coadjutor, F. R. Dixon Nuttall of Prescot, Lancs., who was able to identify all that he found, but did not find two species one of which I think is an entirely new species. Having, therefore, lost the only two specimens I pickled, I must hope to take it again at Sutton Broad. This has been almost my first attempt at the pickling process, and I therefore find it very difficult. Perhaps a high power positive microscope would help to make it easier.

Before I leave the subject of the actual work at the table, let me here express my gratitude and admiration for the comfortable and convenient arrangement of the laboratory. We amateurs who are used to working at a cramped little table in our own studies, can appreciate the professional arrangement which allows everything to be at hand without being in the way.

The description of one day's work will serve as a type of the general method which I pursued at the Laboratory. Starting out with a boat (another of the useful things provided), a basket of big bottles, a pickle jar, and a small box of corked and numbered tubes, a telescopic walking stick into which the Rotifer net can be screwed, or the hook to hook up weeds as occasion requires, one drops the tow net overboard and rows off to a likely spot. The spot called The Heater on Sutton Broad was one of the first I chose, and turned out to be one of the best.

On the way a sample of the produce of the tow net bottle is emptied into a tube (1) and the locality recorded, the rest is poured into a sort of pot pouri jar—No. 1.

Arrived at the Heater, first of all a general sample of the free swimmers is taken and labelled tube (2). Then a bunch of weeds is hooked up, put into the pickle jar, half full of water, violently shaken and the contents strained into the Rotifer net. A sample of this put into a tube (3) and the rest poured into Big jar No. 2. More weeds are treated in the same way until bottle No. 2 is filled. Then the tow net is dropped again, and we row off to another locality. The same process being repeated, care being taken to wash the rotifer nets thoroughly between two catches in order to keep the localities distinct. Two or three localities in one day are quite enough for one night's work.

Before leaving any locality, a specially nice piece or two of weed is carefully hooked up without being too much disturbed and put straight into the big bottle of that locality, and certain special weeds good for producing the fixed Rotifers are selected and put into the tiny tube of that locality. On returning to the Laboratory, care must be taken to uncork the tubes at

once, as many Rotifers die quickly when the air is excluded.

When the search is to begin, it pays to have a strong light and to set the bottles and tubes close to it, as Rotifers often swim towards the light, and can be more easily taken with the pipette from the bottle and transferred to the microscope tank.

Having secured good illumination with a dark background and filled the tank by drawing the water from bottle No. 1 with a big pipette, we put in a bit of weed and the search commences, and a list is made for that locality.

Three or four fillings of the tank will generally exhaust most of the Rotifers from even a *large bottle*, and my *tubes* generally hold about two tanks full.

In my system of recording I always endeavour to give some idea of the abundance or otherwise of a species, and it is strange in a place like Sutton Broad how much this varies in different parts of the Broad. For example, in the Heater, 55 species, in the main dyke close by, 30 species were found.

Total 67 { 12 in M.D. not in Heater
18 in both.
37 in Heater not in M.D.

Out of the 18 found in both

10 were more common in Heater than in M.D.
6 were about equally common, or rare.
2 were more common in Main Dyke than in H.

That is only one example of the erratic occurrence of species.

It seems to me that the occurrence or the frequency of occurrence of a species is quite a matter of chance within even a few yards of the same piece of water, and under the same conditions of wind, depth, vegetation, bottom, etc. Certain spots are, however, always good, and one can tell almost at once which is likely to be good by the vegetation. I gave a thorough trial to Sutton Broad, and took a fair sample of Barton, but the wind checked me in the latter case, except on Thursday, 10th.

My programme was as follows:

Monday, 7th. Sutton Broad Heater and Dykes on the way there, and on towards Stalham.

Tuesday, 8th. Corner of Barton Broad and dykes and river on the way there.

Wednesday, 9th. Sutton Broad Fish Pond, far North border and three little dykes close to the laboratory.

Thursday, 10th. Barton Broad, N., S., E. and W.

Tuesday, 15th. Sutton Staithe—Dyke on the way. The Marsh. The Pulk holes, and a few little dykes round laboratory.

Wednesday, 16th. Hickling Broad, and a few dykes in that district.

A few remarks on particular groups, genera, and species will perhaps be pardoned by members who have not studied these animals and may be of interest to those who have.

To begin with the Rhizota, or fixed Rotifers. I was disappointed with these. None were abundant except *Melicerta ringens*.

Only two species of floscules occurred, both in Hickling Broad, and one of them in a tiny hole cut in the marsh close to the laboratory.

The queen of Rotifers, *Stephanoceros eichornii*, occurred sparingly in one spot, the Fish Pond in Sutton Broad.

Conochylus volvox was common in two or three localities in Sutton Broad, but I entirely failed to distinguish its newly described congener *unicornis*.

The best takes in this group were quite a fair number of *Melicerta janus* on the east side of Barton, three *Megalotrocha alboflavicans* in the Heater, several *Œcistes umbella* and *intermedius* east of Barton.

Amongst the Bdelloida, or "creepy, crawly" (as a little friend called them) Rotifers I am rather at sea. I confess I can only distinguish about twenty of this group and only made certain of nine in this district.

Turning to the illoricate free swimmers, two species of *Asplanchna* occurred: *brightwellii* common on the west of Barton, and *priodonta* scarce at the north end of Barton.

That extraordinary assymetrical *Elosa worrallii* turned up in one of the small dykes.

Five species of *Synchæta* occurred nearly everywhere, as also did the common *Polyarth. platyptera*.

The usually abundant *Triarthra longiseta* was almost absent, only three specimens being found on the west of Barton.

The fascinating little *Gasteropus minor* did just put in an appearance at North Barton. Three specimens only.

The giant *Copeus chrenbergii* occurred both in Sutton and Barton Broads, and I was delighted to find *Furcularia cimolius* (Gosse's *Rattulus cimolius*).

I have often longed to see this speices, and now that I have seen it I am positive that it is a Furcularia, and not a Rattulus.

Pretty little *Furcularia longiseta* was rare, but occurred in most places, except Barton and Hickling.

Proales petromyzon occurred associated with *Volvox globator*.

Proales daphnicola also occurred, and through the kindness of Mr. Robert Gurney, I am able to give the names of the species of Entomostraca with which it was associated. I found it on three different hosts, *Daphnia pulex*, *Sida chrystallina*, and *Eurycercus lamellatus*.

Amongst the *Diglena*, two specimens of *grandis* turned up in east of Barton. *Forcipata* and *catellina* also occurred, and my own species, *Diglena rostrata*, once only far north of Sutton.

We pass on to the loricated free swimmers. The *Rattulidæ* were very abundant.

Eight species of Rattulus occurred, *carinata*, *lophoessa*, *scipio*, *elongata*, *rattus*, *bicornis*, *stylata*, and *bicristata*.

The genus *Diurella* has been recently revised by Jennings, of the U.S. Fishery Commission, assisted by Mr. Rousselet, and my friend, Mr. Dixon Nuttall.

I was able, by sending some samples to the latter, to determine *tigris*, *porcellus*, *tenuior*, *weberi*, and *intermedia*.

I was delighted to come across three *Scaridium eudactylotum* in the Fish Pond, and four *Stephanops unisetatus* in the Heater, both of which I had never taken myself before.

Passing on to the genus *Diaschiza*, a genus in which I feel very much at home after some years spent on its special study, I was delighted to find thirteen species represented in the Broads, most of them occurring only in the fish pond,

as far as Sutton is concerned; I account for this by the abundance of thriving weeds. Nuttall's species *ventripes*, and our joint species *Derbyi*, both turned up. And here also I found three or four specimens of what I hoped Nuttall would agree was a species new to science, but unfortunately in pickling them and posting them to him, or in his search at the other end, they got lost. They occurred in the Marsh.

Seven species of *Euchlanis* occurred in large quantities and in most localities, and five species of *Pterodina* including *reflexa*, *incisa*, and *parva* is not bad.

The genus *Brachionus* was very remarkable by its scarcity.

Only two specimens of *Urceolaris* occurred in the whole of Sutton Broad.

Only two specimens of *pala* from East Barton.

Only one specimen of *urceolaris* from West Barton.

Only three specimens of *bakeri* from West Barton; and very few *angularis* from South and West Barton. For these usually abundant species this is a remarkable scarcity, and was rather a treat than otherwise.

Finally, five species of *Notholca* were scattered about in the most unlikely places, including tiny dykes round the laboratory.

I have drawn up a full complete list with localities, quantities and dates, a shortened form of which is here printed.

Through the kindness of another member of this Society I have had sent me a list of the Rotifers found in another part of the Broad District.

That list contained about *forty* species. Why it is so small I can't understand, perhaps the author confined his attention too much to the open river; perhaps he was unaware of the bottle shaking process.

I do not see why there should not be a very much larger list. There ought to be about 400 species at least. In my six days I found 120 species, and am sure that if the wind and weather had been better my take would have been larger.

LIST OF ROTIFERA AND LOCALITIES IN THE NORFOLK BROADS.

NOTE.—*r.*, rare; *f.*, few; *c.*, common; *a.*, abundant.

FLOSCULARIA CAMPANULATA, *r. Dykes*, *f.* Hickling.
F. CORNUTA, *f.* Hickling.
STEPHANOCEROS EICHORNII, *f.* Sutton.
MELICERTA RINGENS, *a.* Sutton, *f.* Barton, *c.* Hickling.
M. JANUS, *f.* Barton.
OECISTES CRYSTALLINUS, *c.* Barton.
O. UMBELLA, *c.* Barton.
O. INTERMEDIUS, *f.* Barton.
MEGALOTROCHA ALBOFLAVICANS, *r.* Sutton.
CONOCHYLUS VOLVOX, *c.* Sutton.
PHILODINA ERYTHROPHALMA, *c.* Sutton, *c.* Barton, *f.* Hickling.
P. CITRINA, *f.* Sutton, *f.* Barton.
P. ACULEATA, *f.* Sutton, *f.* Barton.
ROTIFER MACRURUS, *c.* Sutton, *c.* Barton, *f.* Hickling.
R. TARDUS, *f.* Sutton, *f.* Barton, *f.* Hickling.
R. NEPTUNIUS, *f.* Sutton, *r.* Barton.
CALLIDINA ELEGANS, *f.* Sutton, *f.* Barton.
C. BIDENS, *f.* Sutton, *f.* Barton.
ADINETA VAGA, *f.* Sutton.
ASPLANCHNA BRIGHTWELLII, *c.* Barton.
A. PRIODONTA, *f.* Barton.
ASCOMORPHA VIRIDIS, *c.* Sutton, *c.* Barton, *f. Dykes.*
ELOSA WORRALLII, *r.* Sutton, *r. Dykes.*
SYNCHÆTA PECTINATA, *a.* Sutton, *a.* Barton, *c. Dykes*, *f.* Hickling.
S. OBLONGA, *f.* Sutton, *f.* Barton, *f. Dykes*, *c.* Hickling.
S. TREMULA, *c.* Sutton, *c.* Barton, *c. Dykes*, *f.* Hickling.
S. GYRINA, *a.* Sutton, *a.* Barton, *c.* Hickling.
S. KITINA, *f.* Sutton. *f. Dykes*, *f.* Hickling.
POLYARTHRA PLATYPTERA, *a.* Sutton, *a.* Barton, *a. Dykes*, *a.* Hickling.
TRIARTHRA LONGISETA, *r.* Barton.
HYDATINA SENTA, *r.* Sutton.
GASTEROPUS MINOR, *r.* Barton.

Taphrocampa annulosa, *a.* Sutton, *c. Dykes.*
Notommata aurita, *c.* Sutton, *f.* Barton, *r. Dykes*, *r.* Hickling.
N. cyrtopus, *f.* Sutton, *f.* Barton, *f. Dykes.*
N. tripus, *r. Dykes*, *r.* Hickling.
N. saccigera, *c.* Sutton.
N. naias, *f.* Sutton, *f.* Barton.
Copeus ehrenbergii, *f.* Sutton, *f.* Barton.
C. pachyurus, *f.* Sutton.
Furcularia longiseta, *r.* Sutton. *r. Dykes.*
F. (not rattulus) cimolius, *r. Dykes.*
Proales decipiens, *f.* Sutton, *c.* Barton, *a. Dykes*, *a.* Hickling
P. felis, *r.* Sutton.
P. petromyzon, *c.* Sutton, *c. Dykes*, *f.* Hickling.
P. daphnicola, *f.* Sutton, *c. Dykes.**
Eosphora aurita, *f.* Sutton.
Diglena grandis, *r.* Barton.
D. forcipata, *f.* Sutton, *f.* Barton. *f.* Hickling.
D. catellina, *f.* Sutton, *r.* Barton, *r. Dykes*, *f.* Hickling.
D. rostrata, *r.* Sutton.
Rattulus carinata, *a.* Sutton, *c.* Barton, *c. Dykes*, *f.* Hickling
R. lophoessa, *a.* Sutton, *f.* Hickling.
R. scipio, *c.* Barton.
R. elongata, *a.* Sutton, *a.* Barton, *a. Dykes.*
R. rattus, *a.* Sutton, *c. Dykes.* *f.* Hickling.
R. bicornis, *a.* Sutton, *f.* Barton, *f. Dykes*, *c.* Hickling.
R. stylata, *c.* Sutton, *f. Dykes.*
R. bicristata, *c.* Sutton, *f.* Barton, *f. Dykes*, *f.* Hickling.
Diurella tigris, *r.* Sutton, *r. Dykes.*
D. porcellus, *a.* Sutton, *c.* Barton, *c. Dykes*, *f.* Hickling.
D. tenuior, *a.* Sutton, *f.* Barton, *a. Dykes*, *f.* Hickling.
D. weberi, *c.* Sutton, *c.* Barton, *a. Dykes.*
D. intermedia, *c.* Sutton, *c.* Barton, *f.* Hickling.
Dinocharis pocillum, *a.* Sutton, *c.* Barton, *f. Dykes*, *f.* Hickling.
D. tetractis, *c.* Sutton, *f.* Barton, *f. Dykes*, *c.* Hickling.

* *Proales daphnicola* was found on *Daphnia pulex*, *Sida crystallina*, and *Eurycercus lamellatus.*

Scaridium longicaudum, *r. Dykes.*
S. eudactylotum, *r.* Sutton.
Stephanops lamellaris, *r.* Sutton.
S. muticus, *r.* Sutton.
S. unisetatus, *r.* Sutton.
Diaschiza gibba, *f.* Sutton, *c.* Barton, *f. Dykes*, *f.* Hickling.
D. exigua, *f.* Barton, *r. Dykes.*
D. pæta, *c.* Sutton, *c.* Barton, *r. Dykes*, *f.* Hickling.
D. tenuior, *f.* Sutton, *f.* Barton, *r. Dykes.*
D. globata, *c.* Sutton, *f.* Barton, *f.* Hickling.
D. hoodii, *c.* Sutton, *f.* Barton, *r. Dykes*, *c.* Hickling.
D. lacinulata, *c.* Sutton, *c.* Barton, *r. Dykes*, *c.* Hickling.
D. gracilis, *r.* Sutton.
D. eva, *f.* Sutton, *c.* Barton, *f. Dykes.*
D. sterea, *f.* Sutton, *f. Dykes*, *f.* Hickling.
D. ventripes, *c.* Sutton, *f. Dykes.*
D. derbyi, *f.* Sutton.
D ? Megalotrocha, *r.* Barton.
D. sp. nova ? The Marsh, Sutton.
Salpina mucronata, *c.* Sutton, *c.* Barton, *c. Dykes*, *c.* Hickling.
S brevispina, *c. Dykes.*
S. eustala, *r.* The Marsh.
Euchlanis dilatata, *c.* Barton, *c. Dykes*, *f.* Hickling.
E. macrura, *c.* Barton.
E. triquetra, *c.* Sutton, *f.* Barton.
E. deflexa, *f.* Sutton, *f.* Barton.
E. pyriformis, *f.* Sutton.
E. oropha, *c.* Barton, *c. Dykes*, *f.* Hickling.
E. hyalina, *c.* Sutton, *c.* Barton, *f. Dykes*, *f.* Hickling.
Cathypna luna, *f.* Sutton, *c.* The Marsh.
Dystyla flexilis, *f.* Barton, *f.* Hickling.
D. inermis, *f.* Barton, *f.* Hickling.
Monostyla bulla, *f.* Sutton, *f.* Hickling.
Colurus bicuspidatus, *c.* Sutton, *c.* Barton, *c. Dykes*, *c.* Hickling.
Metopidia lepadella, *c.* Sutton, *c.* Barton, *c. Dykes*, *a.* Hickling.

M. SOLIDUS, *f.* Sutton.
M. TRIPTERA, *f.* Sutton.
PTERODINA PATINA, *c.* Sutton, *f.* Barton, *a. Dykes*, *a.* Hickling.
P. MUCRONATA, *f.* Sutton.
P. REFLEXA, *f.* Sutton, *r. Dykes*, *f.* Hickling.
P. INCISA, *f.* Sutton, *r. Dykes.*
P. PARVA, *r.* Sutton.
BRACHIONUS PALA, *r.* Barton.
B. URCEOLARIS, *r.* Sutton, *r.* Barton.
B. BAKERI, *r.* Barton.
B. ANGULARIS, *f.* Barton.
,, var. MINUTUS, *f.* Barton.
ANUREA ACULEATA, *c.* Sutton, *a.* Barton, *f. Dykes*, *c.* Hickling.
A STIPITATA, *a.* Sutton, *a.* Barton, *c. Dykes*, *a.* Hickling.
NOTHOLCA ACUMINATA, *c.* Sutton, *f. Dykes*, *f.* Hickling.
N. LONGISPINA, *f. Dykes.*
N. STRIATA, *f.* Sutton, *c.* Barton, *f. Dykes*, *f.* Hickling.
N. HEPTODON, *c.* Sutton, *r.* Barton, *r. Dykes.*
N. LABIS, *f.* Barton.

XV.

FAUNA AND FLORA OF NORFOLK.

Additions to Hepaticæ.

By Rev. E. N. Bloomfield, M.A., F.E.S.

Read 31*st January*, 1905.

Since my notice of the Hepaticæ was published in the Transactions for 1902-1903, vol. vii., p. 552, three species have been added and more information obtained.

Marchantia polymorpha, L. 27. Near Antingham, very fine, with many male shields. Miss A. M. Geldart.

*Lunularia cruciata, L. 27. On the walls of greenhouses at Sheringham Park, W. H. B. This was formerly confounded with *M. polymorpha*, though abundantly distinct and is probably not uncommon in the county.

Riccia glauca, L. 27. 28. Growing everywhere about Holt, both in East and West Norfolk, W. H. B.

,, *sorocarpa, Bischoff. 27. Sheringham, on a hedge bank, W. H. B.

Ricciocarpus natans, L. 27. In plenty in the Sutton district, but local; sent from Sutton Broad Laboratory.

Radula complanata, L. Various localities, W. H. B.

Lepidozia reptans, L. 27. Edgefield, near Holt, April and May, Rev. R. B. Francis. Engl. Bot. Briston and Hunworth, W. H. B.

Lophocolea heteropylla, Schrad. 27. Briston, on rotten wood, W. H. B.

Kantia trichomanes, L. Fruiting specimens from Holt Wood, 1798. Engl. Bot.

,, *arguta, Nees. 27. Catfield, in roadside ditch, September, 1903, W. H. B.

Scapania aspera, Müll. et Bern. 27. Holt Bog, W.H.B.

,, nemorosa, L. 27. Woods near Holt, 1798, figured from a fruiting specimen. Engl. Bot.

Diplophyllum albicans, L. On shady banks in abundance, fruiting freely at Holt, Aylsham, Stratton Strawless, and throughout the district, W. H. B.

Jungermannia capitata, Hook. (excisa). 27. Figured from Holt Heath. Engl. Bot.

,, incisa, Schrad. 27. Holt Bog, W.H.B.

,, inflata, Huds. 27. Holt in fair quantity, W. H. B.

Nardia scalaris, Schrad. Holt, figured from thence. Engl. Bot.

Sphærocarpus terrestris, Sm. 27. Sheringham, Holt, Baconsthorp, Badham, Barningham, Beckham and Southrepps, in clover and turnip fields and in fallow land, W. H. B. 28. Gunthorpe, W. H. B.

Anthoceros punctatus, L. 28. Gunthorpe, in turnip field, February, 1904, W. H. B.

The species marked * are new to the county.

XVI.

ALONOPSIS AMBIGUA, LILLJ., AN ADDITION TO THE CLADOCERA OF NORFOLK.

BY ROBERT GURNEY, B.A.

Read 28th February, 1905.

COLLECTING was not carried out so energetically during the past year as in 1903, and some of the rarer species recorded in my list were not found again. Still, I have one species

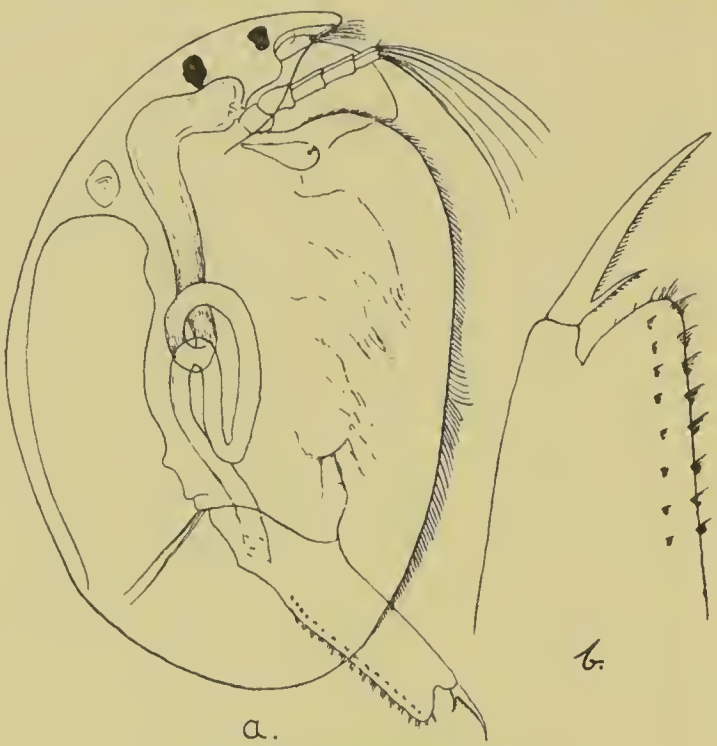


Fig. 5. ALONOPSIS AMBIGUA, Lilljeborg.
a. Side view of female, × 80.
b. Part of the Postabdomen, × 260.

to add which is new not only to Norfolk but also to Great Britain. This species is *Alonopsis ambigua*, Lillj. The only species of the Genus hitherto recorded as British is *Alonopsis elongata*, Sars, which is found in North England but not in

the south and east. This interesting new species was found on September 27, in company with *Scapholeberis aurita* and *Lynceus tenuicaudis*, in a pond at Herringfleet. I claim it as a Norfolk species as Herringfleet is in that part of Suffolk which is usually reckoned as belonging zoologically to Norfolk.

Only two dead individuals were found, but the number of Ephippia discovered showed that more individuals had existed a short time before, and that the colony had died out. This pond had been collected in on August 30 by Mr. R. A. Todd, so that the life of the colony must have been a very short one. It seems likely that the species had been introduced, flourished for a time, and then died out owing to the conditions of life proving unsuitable. If that is so the question remains unanswered, where did it come from ?

XVII.

OBITUARY NOTICE.

C. G. Barrett.

Charles Golding Barrett was born at Colyton, Devon, in 1836, and entered the Civil Service in 1856. In his official capacity he was stationed in many localities—London, Dublin, Haslemere, Norwich, Pembroke, Lynn, and finally London again; while in the course of his work as examiner, during the latter years of his life, he visited various other parts of the country. During the greater part of this time he occupied posts in the lower grades of the Service, but when once he had the opportunity of bringing to the notice of the authorities his really exceptional ability and power of concentration, his rise was very rapid, and it was from almost the highest rank of his department that he retired in 1899,

Mr. Barrett was essentially a field naturalist of the highest order. To a singularly keen power of observation, and an appreciation of minute differences, which enabled him to distinguish almost without hesitation between species so closely allied as to puzzle many an expert, he united a genuine love for nature, which rebelled utterly against the too prevalent idea that, in the lower forms of life, all that is to be done by a naturalist is to differentiate and catalogue the species. An extract from the preface of his greatest work well expresses this feeling: "My aim is, not only to furnish original and accurate descriptions of the perfect insects, and the most reliable descriptions obtainable of their larvæ and pupæ, but also such particulars of their habits and ways, drawn from personal experience and the most reliable records, as shall present them to the reader as creatures which enjoy

their lives, and fill their allotted positions, before they take a more permanent place in the museum or the cabinet." It goes without saying that such a man took a wide interest in Natural History as a whole, and had a very practical knowledge of many of its branches; he was even somewhat of a specialist in Conchology and in Field Botany: but it was to the Lepidoptera that he specially devoted his attention, and among these he made the Tortrices his favourite family, though he did excellent work also in clearing up some of the difficult groups of the Crambites. It is perhaps not too much to say that he stood in a class by himself as an authority on the Tortricina.

As a collector, Mr. Barrett was singularly "lucky." Luck, in such pursuits, persistently follows the man who combines the independence of mind which leads him to think for himself with patient and enthusiastic work. At every fresh post he occupied, Mr. Barrett discovered novelties or rarities: Dublin yielded *Lithosia canjola*, *Dianthoecia capsophila*, *D. barrettii*, and *Gelechia tarquiniella*. Haslemere, among many notable captures, furnished him with the specimens of the lovely *Madopa salicalis*, with which he supplied nearly all the great collections of his day. At Norwich, he captured, almost in the city itself, that great rarity *Hydrilla palustris*, and added to the British fauna such species as *Sericoris doubledayana* and *Phoxopteryx paludana*. At Pembroke, a rather disappointing locality, he yet re-discovered the lost *Diasemia literalis*, and filled our series with this little beauty, which comparatively few knew even by sight, besides differentiating *Botys stachydalis*, of which many specimens already existed in cabinets mixed with *B. sambucalis*. At Lynn, though now too fully occupied with official duties to devote much time to entomology, he discovered, in conjunction with Mr. Atmore, the fine *Eupithecia extensaria*, which had previously a very doubtful claim to a place on the British list. Even in London, he captured such rarities as *Sterrha sacraria* in his early days, and in his second stay, *Botys lupulinalis*, besides making known the habits and haunts of many obscure Crambites feeding upon grocers' stores, &c. Certainly no

lepidopterist of his time has had the pleasure of adding so many novelties to our list, or of working up so many rare and little known species.

The treasures of his duplicate boxes, and the still greater treasures of his vast experience, he placed freely at the disposal of every earnest collector with whom he came in contact. The writer will never forget the large-hearted generosity with which Mr. Barrett encouraged him—then an enthusiastic boy—to pick whatever he liked from store boxes that seemed inexhaustible, and introduced him freely to his choicest collecting grounds.

As a writer, Mr. Barrett was indefatigable, but during the greater part of his life he was deterred by want of opportunity from anything more ambitious than articles in magazines, or the Transactions of our own Society. To the latter he contributed eight articles, including the valuable list of Norfolk Lepidoptera. During the earlier years of his life he wrote several articles for the 'Entomologist's Weekly Intelligencer' and the 'Zoologist,' while in the Entomologist's Monthly Magazine,' of which he was an editor for many years, his name appears as the author of no less than 330 contributions. Of these the Notes on Tortrices, published at irregular intervals, are perhaps the most important. His great work on British Lepidoptera was commenced in 1892, and has reached the ninth volume. Deeply as we regret that its completion must pass into other hands, it is a matter for congratulation that Mr. Barrett has left notes sufficient for Vol. x., carrying the subject down to the end of the Tortrices.

Mr. Barrett's death will be felt in other than scientific circles ; his energy was prominently displayed in the cause of temperance, and in the religious work of the Wesleyan Denomination, of which he was a member ; while those of us who were privileged to work with him, and to enjoy his personal friendship, feel that we have sustained an irreparable loss.

F. D. W.

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8 SEP 1905

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CONTENTS.

	List of Officers	v
	List of Members	vi
	Statement of Accounts	x
	Catalogue of Additions to the Library	xi
	President's Address	1
I.	On Migration other than of Birds, with Special Reference to the Cetacea. By Thomas Southwell, F.Z.S., V.-P.	15
II.	Abstract of an Address on Respiration in Sand-Burrowing Crabs. By Walter Garstang, M.A., F.Z.S., *President*	22
III.	Remains of the Neolithic Age in Thetford District. By W. G. Clarke	25
IV.	Distribution of *Sonchus palustris*, L., and *Atriplex pedunculata*, L., in England. By Arthur Bennett, F.L.S	35
V.	The Life History of the Cladocera. By Robert Gurney, B.A.	44
VI.	A Study of the Aquatic *Coleoptera* and their Surroundings in the Norfolk Broads District. By Frank Balfour Browne, M.A., F.R.S.E., F.Z.S.	58
VII.	The *Hydrachnids* of the Norfolk Broads. By Chas. D. Soar, F.R.M.S	83
VIII.	Meteorological Notes. 1904. By Arthur W. Preston, F. R. Met. Soc.	90
IX.	Notes on the Herring Fishery of 1904. By T. J. Wigg. *Hon. Sec. Gt. Yarmouth Section*	97
X.	On *Bagous lutosus*, Gyll., in Norfolk; with some Collateral Matter. By James Edwards, F.E.S.	102
XI.	Some Additions to the Norwich Castle-Museum in 1904. By Frank Leney	107
XII.	Natural History Notes from Yarmouth. By A. H. Patterson	111
XIII.	Fauna and Flora of Norfolk. Lichens of Norfolk and Suffolk. By Rev. E. N. Bloomfield, M.A.	117
XIV.	Fauna and Flora of Norfolk. Rotifera. By Rev. R. Freeman	137
XV.	Fauna and Flora of Norfolk. Additions to Hepaticæ. By Rev. E. N. Bloomfield, M.A., F.E.S.	148
XVI.	*Alonopsis ambigua*, Lillj., An Addition to the Cladocera of Norfolk. By Robert Gurney, B.A.	150
XVII.	Obituary Notice. C. G. Barrett	152

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Y

Young J. J. Baldwin, M.A., M.B.O.U. Richmond Park, Sheffield

The Treasurer in Account with the Norfolk and Norwich Naturalists' Society, Year ending March, 1906.

Dr.	£	s.	d.	Cr.	£	s.	d.
1905—6. Balance at Messrs. Barclay's Bank	4	3	9	1905—6.			
To Subscriptions:—	£	s.	d.	By Fletcher and Son, *Transactions*	45	17	0
1 for 1900—1901	0	5	0	,, Ditto Stationery	0	1	9
1 ,, 1901—02	0	5	0	,, Goose & Son, Printing and Stationery	4	9	6
3 ,, 1902—03	0	15	0	,, Postage Stamps	6	7	5
7 ,, 1903—04	1	15	0	,, Insurance	0	9	0
16 ,, 1904—05	4	0	0	,, Year Book of Societies	0	6	0
172 ,, 1905—06	43	0	0	,, Banker's Cheque Book	0	1	0
11 ,, 1906—07	2	15	0	,, Norfolk and Norwich Library	1	1	0
1 ,, 1907—08	0	5	0	,, Doorkeeper at Museum	1	0	0
1 ,, 1908—09	0	5	0	,, Assistant Secretary's Salary	5	0	0
	53	5	0	,, Bookbinding (162 vols.)	17	9	10
,, Additional payments	1	0	0				
,, Sale of *Transactions*	2	7	4				
,, Donation	0	10	6				
,, Ditto for Bookbinding	2	0	0				
,, Sale of Duplicates	2	8	4				
,, Transferred from Life Membership Fund	5	0	0				
,, Ditto (Interest) ..	2	0	5				
,, Balance due to Treasurer	9	7	2				
	£82	2	6		£82	2	6

LIFE MEMBERSHIP FUND.

1905.	£	s.	d.	1905.	£	s.	d.
To Balance in Norfolk and Norwich Savings Bank ..	75	0	0	By Transferred to General Account	7	0	5
,, Interest	2	0	5	,, Balance in Norfolk and Norwich Savings Bank ..	70	0	0
	£77	0	5		£77	0	5

Norwich 27th March, 1906.

Examined with vouchers and found correct,

STEPHEN WM. UTTING, *Auditor.*

List of the Publications received by the Society as Donations or Exchanges from March, 1905.

Animal Reproductions, An Essay on. By Abbé Spallanzani, F.R.S. Translated from the Italian. London. 1769.
From Mr. J. H. Gurney, F.Z.S.

"Aquila." A Magyar Madartani Központ Folyoirata. 21 Reprints. Budapest. 1896—1903. *Presented by Mr. T. Southwell, F.Z.S.*

Augustana College Library Publications, Number 5 of. A Preliminary List of Fossil Mastodon and Mammoth Remains in Illinois and Iowa. By Netta C. Anderson. On the Proboscidean Fossils of the Pleistocene Deposits in Illinois and Iowa. By Johan August Udden. 1905.

Bacillaria (Diatoms) of the U.S. Geological Survey of the Territories, and Trochiscia moniliformis, E.C.M., a form of Bacillaria. Arthur M. Edwards, M.D. *From the Author.*

Bath Natural History and Antiquarian Field Club, Proceedings of the. Vol. x. No. 4. 1905.

Belfast Naturalists' Field Club. Annual Report and Proceedings. Series II. Vol. v. Part 4. 1904—05.

Belge de Géologie, Procès-Verbaux de la Société. 19ieme. Année. Tome xix. Fascicules 1—2, 1905. Fascicules 3—4, 1906. Bruxelles.

Berwickshire Naturalists' Club. Vol. xix. Part 1. 1903. Berwick-on-Tweed.

Biographisches über die drei Naumannes. Bearbeitet von Paul Leverkühn. Gera-Untermhaus. 1904.
From Mr. J. H. Gurney, F.Z.S.

Biology. Letters from F. Field, M.A., LL.D. Norwich, May, 1876. 4 pp.

Bird Migration in Great Britain and Ireland. Fourth Interim Report of Committee of B. A., Glasgow, 1901.

——— Fifth Interim Report of Committee of B.A., Belfast, 1902.
From Mr. J. H. Gurney, F.Z.S.

Birds of the Philippine Island, A Hand-list of the. By R. C. Mc Gregor and D. C. Worcester. Manila, 1906.
Presented by Mr. J. H. Gurney, F.L.S., F.Z.S.

Birds from Mindoro and small adjacent Islands. 1. Birds, Notes on Three Rare. By R. C. Mc Gregor. Manila, 1905.
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Bristol Naturalists' Society, Proceedings of the. New Series. Vol. viii. Part 3. Vol. x. Part 1, 2. Fourth Series. Vol. i. Part 1.

British Association for the Advancement of Science. Report of 74th Meeting, held at Cambridge, 1904. Report of Corresponding Societies' Committee for 1905.

Brooklyn Institute of Arts and Sciences. Cold Spring Harbor Monographs.

No. 3. The Salt Marsh Amphipod: *Orchestia palustris*. M. E. Smallwood.

No. 4. The Life History of Case Bearers. 1. *Chlamys plicata*. E. M. Briggs.

No. 5. The Mud Snail: *Nassa obsoleta*. A. C. Dimon.

Cardiff Naturalists' Society, Transactions of the. Vol. xxxvii., 1904, and Vol. xxxviii., 1905.

Croydon Natural History and Scientific Society, Proceedings and Transactions of the. February, 1904—January, 1905.

Danicæ, Nomenclator Botanicus inserviens Floræ. G. C. Oeder. Hafniae. 1769. *Presented by Mr. J. H Gurney, F.L.S., F.Z.S.*

Ealing Scientific and Microscopical Society, Report and Transactions for 1904—05.

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——— Geological Society, Transactions of the. Vol. viii. Part 3. 1905.

——— Proceedings of the Royal Society of. Vol. xxiv. 1901—03. Vol. xxv. Part 1. 1903—05. Part 2. 1905.

Essex Naturalist, The, being the Journal of the Essex Field Club. Nos. 23, 24. Vol. ix. Nos. 1—4, 7—18. Vols. x., xi., xii., xiii. Parts 1, 2, 3 of Vol. xiv.

Fishery Industries, History and Present Condition of the. G. Brown Goode. Seal Islands of Alaska. H. W. Elliott. U. S. Department of the Interior. Washington, 1881.
From Mr. Thomas Southwell, F.Z.S.

Flora of the Outer Hebrides, Contribution to a. Reprinted from Ann. and Mag. Scot. Nat. Hist. July, 1905. By Arthur Bennett, F.L.S. *From the Author.*

Food of Fishes collected during 1903, Report on the. By R. A. Todd, B.Sc. (Asst. Naturalist on the Staff). 1905. Reprinted from International Investigations. Marine Biological Association. Report 1. 1902—03. *Presented by the Author.*

Der Formenkreis Falco Hierofalco und die Stellung der Ungarischen Würgfalken in demselben. O. Kleinschmidt. Budapest, 1901.

Geographical Journal, The. Including the Proceedings of the Royal Geographical Society. April, 1905—April, 1906. *Presented by Mr. H. G. Barclay, F.R.G.S.*

Geological Institution of the University of Upsala, Bulletin of the. Vol. vi. No. 11—12. 1902—03. Upsala, 1905.

Glasgow, Natural History Society, Transactions of the. Vol. vii. (New Series). Part 1. 1902—03.

Harvard College, Annual Report of the Curator of the Museum ofComparative Zoology at, for 1904—05. Cambridge U.S.A., 1905.

——— Bulletins of the Museum of Comparative Zoology at. Vol. xlii. : Geological Series. Vol. vi. No. 6, The Sand Plains of Glacial Lake, Sudbury, J. W. Goldthwait. Vol. xlvi. : No. 4, Three Letters from A. Agassiz, on the Cruise of the U. S. Fish Commission Steamer "Albatross." No. 5, Vertebrata of Gorgona Island, Colombia. No. 6, Description of a New Genus of Isopods. No. 7, Notes on Bermudian Fishes, Thomas Barbour. Vol. xlvii, Nemerteans of the West and Northwest Coasts of America, W. R. Coe. Vol. xlvi. : No. 8, Mammals and Birds of the Pearl Islands, Thayn and Banys. No. 9, Craspedotella, a new Genus of the Cystoflagellata, an example of Convergence, C. A. Kofoid. No. 11, New Plagiostomia, Samuel Garman. No. 12, Vertebrata from the Savanna of Panama. Geological Series, Vol. viii. : No. 1, Glaciation of the Sawatch Range, Colorado, by W. M. Davis. No. 2, The Wasatch Canyon, and House Ranges, Utah, by W. M. Davis. Vol. xlvi. : No. 10, Zur Anatomie von Pentacrinus decorus, Wy. Th. von August Reichensperger. Vol. xlviii : No. 1, The Spermatogenesis of Scolopendra Heros, by M. W. Blackman. No. 2, Development of the Oculomotor Nerve, etc., in the Chick. F. W. Carpenter. Vol. xlvi. : No. 13, Octaenemus, W. E. Ritter. Vol. xlix., Geological Series, Vol. viii., No. 3, Post-Pleistocene Drainage Modifications in the Black Hills and Bighorn Mountains, by G. R. Mansfield.

Hastings and St. Leonards, Natural History Society, Twelfth Annual Report, 1905.

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Hull Scientific and Field Naturalists' Club, Transactions of the. Vol. iii. Part 3, 1906.

Ibis, The, A Quarterly Journal of Ornithology. April, 1905—April, 1906. *Presented by Mr. G. F. Buxton.*

Linnean Society, Journal of the. Zoology. Vol. xxvii., No. 178. Vol. xxviii., Nos. 179—186. Vol. xxxix., Nos. 187—191. Botany. Vol. xxxiv., Nos. 240—243. Proceedings. October, 1900—1904. List of the, 1900—1905. Charter and Bye-laws, 1904. Revised Bye-laws, 1904.
Presented by Mr. J. H. Gurney, F.Z.S.

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——— Writings of C. G. Lloyd, Index of the. Vol. i. 1898—1905. Cincinnati, Ohio, U.S.A.

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Montevideo, Anales del Museo Nacional de. Flora Uruguaya (11 Entrega). Tomo 11 (continuacion) and Ultima Entrega. Primera contribucion al estudio de la Cartografia Americana. Por R. R. Schuller.
From Professor J. Arechavaleta, Director General.

Moscou, Bulletin de la Société Impériale des Naturalistes de. Année 1904. Moscou, 1905.

Naturalist, The. A Monthly Journal of Natural History for the North of England. 4 vols. 1899—1902.
Presented by Mr. J. H. Gurney, F.Z.S.

Najas Marina in the Megaceros-Marl of Lough Gur. By Clement Reid, F.R.S. Reprinted from Irish Naturalist. Vol. xiii. Dublin, 1904. *Presented by the Author.*

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Northamptonshire Natural History Society and Field Club, Journal of the. Vol. xiii. Nos. 101—104. March to December. 1905.

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Nottingham Naturalists' Society. 52nd Annual Report and Transactions. 1903—04. 53rd Annual Report and Transactions, for 1904—05.

Nova Scotian Institute of Science. Proceedings and Transactions of the. Vol. xi. Part 1, 1902—03. Halifax, Nova Scotia.

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Recensio critica automatica of the Doctrine of Bird-Migration. Otto Herman. Budapest, 1905.
Presented by Mr. T. Southwell, F.Z.S.

Rennes, Travaux Scientifiques de l'Université de. Tome iii., 1904.

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Royal Institution of Great Britain, Proceedings of the. Vol. xvii. Part 3. No. 98, 1906.

Schwankung, der Angaben über die Ankunft der Zugvögel, Die. Jakob Hegyfoky. Budapest, 1897.
From Mr. T. Southwell. F.Z.S.

Sciences Naturelles de l'Ouest de la France, Bulletin de la Société des, 1901—1904. Nantes.

Scientific Instruments, Catalogue of. Physics. Vol. i. 3rd edition, 1905. *Presented by Messrs. Philip Harris & Co., Ltd.*

Scientific and Learned Societies of Great Britain and Ireland, Official Year-book of the. 1905. *Purchased by the Society.*

Smithsonian Institution, Annual Report of the. Year ending 30th June, 1904. Washington, 1905.

South London Entomological and Natural History Society, Proceedings of. 1904—5.

Structural Relations of Organized Beings, On the. H. E. Strickland, M.A., F.G.S. Read before Ashmolean Society of Oxford, 10th March, 1845. *From Mr. J. H. Gurney, F.L.S.*

Vom Vogelzug in Frankreich. Jakob Hegyfoky. Budapest, 1899. *From Mr. T. Southwell, F.Z.S.*

Wisconsin Academy of Sciences, Arts, and Letters, Transactions of the. Vol. xiv. Part 2. 1903. With 22 Plates. Madison, Wisconsin, U.S.A., 1904.

Zoological Society of London. Reports of Council. 1884, 1887, 1889, 1890, 1893, 1894, 1895, 1896—97, 1900—01, 1903—04. *From Mr. J. H. Gurney, F.Z.S., F.L.S.*

Zoologist, The. A Monthly Journal of Natural History. April, 1905—April, 1906. *Presented by Mr. G. F. Buxton.*

ADDRESS.

Read by the President, Mr. Eustace Gurney, *to the Members of the Norfolk and Norwich Naturalists' Society, at their Thirty-seventh Annual Meeting, held at the Norwich Castle-Museum, March 27th*, 1906.

Ladies and Gentlemen—We have to record losses to the Society, by death, of Colonel Irby, Mr. F. Danby Palmer, Mr. W. E. Baker, Mr. H. E. Buxton, and Admiral Hamond.

The late Colonel Irby presented some valuable books to the library of the Society, a list of which appeared in our last year's 'Transactions.'

Mr. F. Danby Palmer was instrumental in forming the Great Yarmouth Section of our Society, though illness prevented him latterly from taking any further part in its work.

Mr. W. E. Baker was not an active member, probably owing to his living at some distance from Norwich.

Admiral Hamond was a life-member of the Society, and like many other members of his family, was much interested in Natural History.

Mr. H. E. Buxton was one of the early pioneers of Alpine mountaineering, and assisted in the preparation of some of the early maps of the Alps. He was also much interested in Botany, and discovered a hybrid Narcissus in the Pyrenees. He was President of Breydon Wild Birds Protection, and as Vice-Chairman of the Suffolk County Council, took an active part in the promotion of the Wild Birds Protection Bill.

The actual expenditure of the Society has again exceeded the income, and the proposals of the Committee for altering the law relating to subscriptions have been brought to your notice in the circular announcing the annual meeting. In the same circular, the regulations proposed by the Journal Committee, with regard to the publication of papers in the 'Transactions,' have been laid before you. You have, this evening, approved of the adoption of these regulations, and they will henceforth become bye-laws of the Society.

Twelve new members have been added to the Society during the session. One member has resigned, on leaving the district, and about three others have paid no subscription for several years, and may be considered as no longer members. The total number of members now stands at about 270.

Donations of books and periodicals have been made by Mr. J. H. Gurney, Mr. T. Southwell, Mr. R. A. Todd, Mr. Hugh G. Barclay, and Mr. G. F. Buxton. Mr. J. H. Gurney also kindly presented £2 to the fund for book-binding. This amount, and the £12 voted for that purpose at the last Annual Meeting, have been expended during the session. This has resulted in a considerable improvement in the appearance of the shelves in the library, over 160 volumes having been bound.

The attendance at the evening meetings has continued at about the average of the preceding session.

On 25th April, 1905, two papers were read which had been held over from the February meeting, owing to want of time. Mr. Patterson read notes on the exploits of some of the old Breydon gunners, and Mr. J. H. Gurney communicated some notes from Major Buchanan on "Birds observed in Kashmir."

30th May, a paper on "Norfolk Rotifera" (published last year), by Rev. R. Freeman, was discussed. Rev. E. H. Kinder exhibited a pair of hybrid Doves. Mr. A. Bennett sent a note on the finding of *Holosteum umbellatum*, L., in Surrey. The

Report on the Wells Wild Birds Protection Society was read, and Mr. Patterson's "Spring Notes."

On 21st June an excursion of the Society was made to Sutton Laboratory. The party drove to Stalham, lunched there, and proceeded in boats to the Laboratory, from Stalham Staithe. The director of the Laboratory, Mr. F. Balfour Browne, had prepared an interesting exhibition of objects and specimens illustrating the biology, etc., of fresh waters. Some botanising was done on the marshes, great interest being displayed in a dyke which contained a quantity of *Stratiotes aloides*, L., in flower.

26th September, Mr. T. Southwell read and made remarks upon some letters of Robert Marsham, in 1777, and Hamon le Strange, in 1625. He also exhibited a photograph of a Crested Grebe on her nest. The Report of the Wolferton Wild Birds Protection Society was read. Mr. F. Long showed a specimen of *Matricaria discoidea*, D.C., from Surrey, and Mr. Patterson read some Notes.

31st October, the Rev. A. Miles Moss read a paper on "The Butterflies of Switzerland," and exhibited several cases of specimens. Mr. A. Patterson contributed "Notes on Natural History of Breydon," and exhibited a series of water-colour drawings of bird-life by Mr. F. Southgate, R.B.A.

Your President, who had just returned from attending a meeting in London of the delegates of the Corresponding Societies of the British Association, gave an account of the subjects which had been discussed. These were:—The Preservation of our Native Plants. The Law of Treasure Trove, and the Question of Copyright as affecting Scientific Societies. With regard to the first of these, the opinion of the B.A. Committee seemed to be in favour of introducing an Act for the preservation of plants very much on the lines of the Wild Birds Protection Act now in force. The introduction of nature study into schools had, in some places,

led to the wholesale uprooting, not only of common plants, but of rare ones. The law of treasure trove did not much concern a naturalists' society, but was of interest to archæologists. On the question of copyright, the general feeling seemed to be that the diffusion of scientific knowledge would be best served by a not too rigid enforcement of the right, on the ground that when a paper had been published it was, in a sense, given to the world, and had gone out of the possession of the author.

28th November, Miss A. M. Geldart read a paper on *Stratiotes aloides*, L., illustrating it with original coloured sketches, and a map shewing its distribution. Mr. W. H. Burrell sent a note on the occurrence on the Norfolk coast of *Mertensia maritima*, Gray. A communication from Mr. R. Hancock on an uncommon variety of Spider, found at Yarmouth, was read; also a letter from Mr. A. Patterson on the Bearded Titmouse.

30th January, 1906, Mr. T. Southwell read a paper on "The Arctic Whale Fishery from Yarmouth and Lynn," and Mr. W. G. Clarke a paper on "The Classification and Distribution of Norfolk Flint Implements." Mr. A. Bennett sent a paper on "The Distribution of *Holosteum umbellatum*, L., *Statice reticulata*, L., and *Phleum boehmeri*, Wibel," and copies for exhibition of reprints of "The Catalogue of Plants cultivated in the Garden of John Gerard," and the "Libellus" of William Turner.

27th February, Mr. W. A. Nicholson read a paper entitled "A Preliminary Sketch of the Bionomical Botany of Sutton and the Ant District."

Mr. F. Balfour Browne gave an abstract of his second paper on "The aquatic Coleoptera and their surroundings in the Norfolk Broads District." Photomacrographs of Insects, etc., by Mr. J. Edwards were shown by Mr. Thouless, and a Gull killed by lightning by Mr. Roberts. Other papers

were Mr. Preston's "Meteorological Notes, 1905," and Mr. Wigg's "Herring Fishery, 1905," which had to be taken as read, owing to want of time.

I have selected to address you this evening on the subject of :—

LIMNOLOGY.

OR, THE STUDY OF FRESH WATERS.

THE systematic investigation of Lakes is a study of recent growth, though of course a great deal has for a long time been known about the fauna and flora which inhabit fresh water.

It is a branch of Biology which has been largely neglected in favour of marine work, and this is not surprising when we compare the extreme beauty and variety of the living forms, which inhabit the sea, with the small number and sombre colours of fresh water organisms.

Moreover, in this country, surrounded, as it is, by seas teeming with fish, the commercial importance of our fresh waters is not so great as in continental countries, in which the cultivation of food fishes has become an important industry, and is not pursued only for the purpose of furnishing sport to the angler.

In Germany, for example, every attention is paid to the rearing of coarse fish in ponds, and to the protection of game fishes in running streams, not so much for sport as to provide a constant supply of fresh food : and in order that this may be of the best, arrangements are made for keeping the fish alive in tanks of running water till required for the table. Treatises are written on the industry, and a large part of the work of the investigators of Continental fresh waters has a bearing upon fish production.

In the United States the cultivation of Carp is said to be

coming into favour, and improved varieties are introduced from Germany.

Though in this country there are perhaps some of the finest fish hatcheries in the world, less attention is paid to the cultivation and maintenance of ponds and streams than to restocking them, when depleted; and besides the Salmon fishery, there is only the Eel fishery, which is carried on for purely commercial ends. This, of course, was not always so, as the remains of Fish stews to be found near every Abbey and Manor House testify.

Switzerland, Germany, France, and the United States have contributed most largely to the Science of Limnology, while Hungary, Denmark, and other countries are also doing work in this direction.

The scientific study of the subject was neglected in this country (with the exception of a paper by H. R. Mill, on the Bathymetrical Survey of the English Lakes) until in 1900 Sir John Murray and Mr. F. P. Pullar undertook a general survey of all the Lakes,[1] and a beginning was made towards a Bathymetrical Survey of the Scotch Lochs.

In the year 1902 the Sutton Broad Biological Laboratory came into existence, and as this, as far as I know, is the only Limnobiological Station in Great Britain, and concerns itself more especially with the investigation of the Norfolk waters, I think it may be of interest to put before you some account of the subject, and to try to point out some of the special features presented by the Broads.

The term Limnology includes the complete study of lakes from the Geographical, Geological, Physical, Chemical, and Biological standpoints; but it is more especially from the biological point of view that I wish to consider the subject, and this branch we may designate by the word Limno-biology.

The word Lake may be taken to apply to any body of water which is surrounded by land and not in daily

tidal communication with the sea. I say daily tidal communication, because there are bodies of water which are in communication with the sea at some periods, the fauna of which includes brackish water forms; and yet, from their general characteristics, these are fresh water lakes. *e.g.*—The lake of Oued-Tindja is a large lake communicating by a short stream with the lake of Bizerta; it overflows towards the sea in the winter season, and in the summer the level falls and the tide rushes up, carrying the salt water with it. There are also lagoons of a similar kind in the Island of Trinidad.

Lakes may be divided into three kinds :—

1. Lakes proper, in which the water is deep enough to prevent the growth of aquatic plants on the bottom.

2. Ponds which are so shallow that plants may take root on the bottom.

3. Marshes, which are ponds almost filled with vegetation.

There are also subterranean lakes, hot springs, and irrigation pools, which hardly come under such an enumeration; and further, in a study of Limnobiology, running water cannot be entirely neglected, as numerous organisms which inhabit stagnant water also occur in rivers.

Lake basins may be formed in one or more of several ways :

1. By the movements of the earth's crust.

2. By irregularities in the deposits of sedimentary rocks prior to the elevation of the land.

3. By erosion, through wind, water, or ice.

4. By the blocking of the channel of a stream—by landslip, lava-stream, etc.

5. A portion of the sea may be cut off to form an inland lake.

As to the origin of the Broads, I need only refer to Mr. Harmer's admirable account published in Mr. Dutt's book.

The water of a lake becomes salt if the outflow is cut off and evaporation is great : *e.g.*, the Caspian Sea, at the mouth of the Volga, and Lake Shirwa in East Africa. Fresh and salt water lakes may occur in the same drainage system, the lower lake always being the salt one ; *e.g.*, Lake Tiberias and the Dead Sea.

In elevation, lakes range from 20,000 feet above sea-level (these are only small lakes) to 1272 feet below (the Dead Sea). The largest lakes at a great elevation are lake Chincay-Cocha, in Peru, at 13,000 feet, and Lake Titicaca at 12,500 feet. In size they range from the 100,000 square miles of the Lakes of North America downwards ; and in depth down to 4000 feet, as in Lake Baikal.

They present, therefore, every kind of physical environment, and they bear the same kind of relation to the whole waters of the globe that islands do to the surface of the land. Hence the interest of the comparative study of the fauna and flora of fresh waters ; for in the sea there are no sharply defined boundaries, and communication with all parts is easy.

Each lake or lake system is a centre of differentiation, isolated and distinct, and with its own peculiar physical conditions.

The water they contain may be of very various quality as regards temperature, density, chemical composition, and transparency.

Temperature varies, not only with the altitude of the lake, and the latitude, but also with the change of season, and diurnally. It is more constant in deep than in shallow lakes, other factors being equal, and it is greatest at the end of the day and least at the end of the night.

The temperature of the surface of expanses of water shows less variation than that of the layer of air immediately above it.

Daily variations of temperature cease at a depth of 10 or

20 metres in the Lake of Geneva, and yearly variations at a depth of 80, 100, or 120 metres. For comparison it may be added that in the Mediterranean Sea daily variations are felt to a depth of 18 metres, while annual variations occur down to a depth of 400 metres; in the China Sea annual variations cease at a depth of 185 metres with a temperature of 15.6° C.

The climate of lakes is far more rigorous than that of the sea, owing to the greater variations of temperature which occur in the smaller bodies of water.

Of high temperatures a reading of 127.5° C. has been recorded at the bottom of the Great Geyser in Iceland, but that of the surface is between 76° C. and 80° C.

I do not think any life higher than Algae and Bacteria has been found in water of a temperature greater than 60° C. (= 140° F.), in which Crustacea and Insect Larvae have been known to occur.

The organisms most tolerant of heat are the Bacteria, and among them the Bacillus Thermophilus prefers a temperature of between 63° and 70° C.(= 158° F.), but can exist up to 72° C. It finds a temperature of 42° C. too cold for it.

The amount of salts dissolved in the water, and the nature of such salts, has a great influence upon animal life, and perhaps even more upon plant life, and is a more important factor in distribution than climate.

The nature of the substratum is of importance only in the smaller expanses of water, and then chiefly affects those plants which root upon the bottom.

Of animals the majority of families belong exclusively either to salt water or to fresh; but there are distinctive brackish water forms, and there are also quite a number of most interesting species which inhabit on the one hand fresh water, while their close allies are marine, or on the other hand, inhabit the sea, while their close allies are limnetic.

Of the first kind I can only mention *Mysis relicta*, which was found at the bottom of the Scandinavian Lakes by Lovén, and more recently in the North American Lakes, in Ireland, and in Germany, and is almost identical with *Mysis oculata*, inhabiting the North Sea; and the fresh water Medusa Limnocnida, found in Lake Tanganyika by Moore.

The presence of such aberrant fresh water types has given rise to the hypothesis that the lakes, which they now inhabit, were formed by being cut off from the sea, and such lakes have, therefore, been called "Reliktenseen."

But to stamp every lake in which a "Reliktenfauna" has been found, without reference to the geological features, as a former arm of the sea, is, as Forel points out, without warrant, and we must look to some other agents of dispersal (*e.g.*, perhaps even birds) to account for the facts.

An interesting paper has recently appeared by Samter on the distribution of *Mysis relicta* and other "relict" forms in Germany, from which it appears, that of more than forty lakes investigated, in no case was this species found in a single lake which drained into the North Sea, but only in those whose effluents run into the Baltic.

From this the author draws the conclusion that *Mysis relicta* originated from the *Mysis oculata* form at a period when the Baltic was an inland lake (known to geologists as the Ancylus sea) at the end of the Post-Glacial period, and then reached their present habitat by migration up the rivers. These forms are in fact "relictenfauna" of the northern glacial sea, and do not show in any way that each lake in which they occur is a "relictensee."

That limnetic forms have occasionally, at any rate, arisen by immigration from the sea and a gradual adaptation to the new conditions is shown by the case of Cordylophora, which so recently as the middle of the last century was only known to occur in the brackish water of estuaries. Since

then it has migrated into rivers, and is now found in quite fresh water, having even invaded the water pipes of Hamburg, and, in company with the mollusc *Dreissena polymorpha*, completely blocked them. This, with the exception of the common Hydra, is the only Hydroid living in fresh water, and it is of special interest to Norfolk, as it grows freely in the Hickling district. I must add, however, that the waters of Hickling are not absolutely fresh, though I need not go into the causes of that here, further than to say that their saltness is in no way due to tidal influence.

The limnetic species found in the sea are less numerous; while there are many fish which come up the rivers to spawn, there are none, except the Eel, which seek the sea for this purpose.

Of hydrachnids and insects there are several species which have a marine habitat.

The Frog has been found living and spawning at Greifswald, on the Baltic, where, however, the percentage of salt is very small (under 1 %).

The power of resistance of lacustrine animals to salt, and of marine animals to fresh water, is very various, and is not always in proportion to the apparent delicacy of structure.

For example, Semper has experimented with Frogs, and found that they die in two and a half hours in a solution of 5 % of salt, but that they can live without apparent inconvenience in a 1 % solution. Beudant found that by very slowly increasing the quantity of salt in solution he was able to accustom species of Limnea, Physa, Planorbis, and Ancylus to a 4 % solution, while he was quite unsuccessful with Unio, Anodonta, and Cyclas; on the other hand, in the reverse experiment, he found Mytilus able to live in quite fresh water (Mytilus is found in the Baltic, in waters of very low salinity; but there it is dwarfed in size).

Kennel describes a lagoon in Trinidad which is cut off

from the sea, except in February and March, where he found a curious association of animal life: the tadpoles of Frogs and Toads, the larvæ of Flies and Dragon Flies, Water Beetles, and Hydrachnids, together with Mysis and Palaemon, Nereid worms and small Medusae.

The Caspian Sea, which no doubt was formerly connected with the sea, has a curious fauna, combining marine and limnetic species; the percentage of salt varies here from 1.30 to 28.5 (in the Bay of Karabugas, where both animal and plant life are nearly suppressed).

As an instance of what I may call the curiosities of life, I may mention the Sulphur Bacteria, Thiobacteria, which is only found in places where free hydrogen sulphide is present (*e.g.*, sulphur springs and the mud of stagnant water); it seems that this gas is actually necessary to the existence of the bacteria, and they are often crammed full of spherical, refringent masses of pure sulphur.

Mr. Peel is at present engaged at Sutton upon a research into the chemical qualities of the waters of the Broad district, and I hope that his results will be of great value in elucidating the problem of the causes of the local distribution of species.

The transparency of the water of lakes has been studied by means of a white disc (Forel uses one of 20 cm. diameter), which is let down by a line; the depth at which the disc disappears from view is noted, and also the point at which it again reappears on being drawn up, and the mean between these two readings is taken to be the limit of clear vision.

This, of course, varies with the season, according to the amount of solids in suspension, plankton, etc.

On the Lake of Geneva the mean limit of visibility for the winter months is 12.7 m., and for summer 6.6 m.; the maximum observed was 21 m.

The absolute limit of the penetration of light has been studied by means of a photographic plate prepared with

iodo-bromide of silver. For the Lake of Geneva the greatest depth at which any darkening of the plate took place was between 200 and 240 m.

The movements of the water in the large lake basins has been minutely studied, especially in the Lake of Geneva, the Balaton-see, and the Hallstätter-see; and a great deal has been written upon a curious phenomenon, which, though the effects have long been familiar to the people of Geneva, has only lately been recognised as a common one on lakes of large volume; I mean the currents or waves, to which the name "seiche" has been applied. This is caused by changes in the barometric pressure, which produce, as it were, a rocking of the contents of the lake basin; this forms a wave or tide, which is indicated by a rising or falling curve on the recording chart of the limnograph or tide gauge. This wave may be simple or uninodal, or there may be a movement about two axes, which produces a binodal seiche, or there may be a more complicated motion, which Forel has called a plurinodal seiche, and a fourth kind, formed by the clashing of a uninodal and a binodal seiche, to which he has given the name dicrotic.

I show upon the table charts and diagrams to explain these several forms of seiche, taken on the Lake of Geneva and Balaton-see.

A curious seiche is that shown for Balaton-see, which gives a similar curve to that for a marine tide, with two rises and two falls in the twenty-four hours.

Seiches have been detected in the Scotch Lochs and on Lake George in New South Wales as well as in various lakes on the Continent: but they have been studied most fully in the two lakes named above.

Besides movements due to this cause, there are waves caused by earth tremors and by wind, and these waves often obscure the movements due to seiches. A curious form of disturbance, which troubled Forel, was caused by steamers,

the waves of which he has detected by his limnograph 25 minutes before the arrival of the boat itself, and for as much as 2 to 3 hours after they have passed.

The Sutton laboratory has a recording tide gauge, and observations have been taken at Sutton and elsewhere, but as yet with not sufficient completeness to allow definite conclusions to be drawn as to the movements of the water in our rivers.

I show, however, a few charts, which may be of interest as far as they go.

It is not safe to dogmatize from this small number of observations; but the following figures deduced from them are perhaps worth putting before you.

The tidal wave reaches Acle Bridge $2\frac{1}{2}$ to $3\frac{1}{2}$ hours after it reaches Yarmouth Bar; Thurne Mouth about $3\frac{1}{2}$ hours; above Ludham Bridge about 10 hours; and Sutton Broad $15\frac{1}{2}$ to 19 hours. Of experiments made at Sutton, Irstead Shoals, Ludham, and Acle, the greatest difference between one high and the succeeding low water has been 9 inches at Acle, *i.e.*, a wave of $4\frac{1}{2}$ inches, while frequently at Sutton there has been no measurable rise and fall.

The average at Sutton for the period June 14th to 21st of last year was .195 inches.

I would like to call particular attention to the fact that the well-known pleasure steamer, "The Queen of the Broads," caused a wave or tide of $4\frac{1}{4}$ inches (=rise and fall together of $8\frac{1}{2}$) at Acle, and that the passing of wherries at Irstead Shoals has caused a far bigger wave than any which are due to tidal influences.

I hope this year to investigate the movements of our waters more fully, and by means of a second tide gauge to trace more accurately the course of the wave up the rivers.

Besides the transparency, the colour of the lakes has been studied with great care by Forel and Delebecque.

The former devised a scheme of colours by mixing solutions of copper sulphate and potassium chromate in varying proportions, which give a bright blue at one end of the scale, merging into a green, and finally at the other end of the scale showing a yellow.

By means of this scale Delebecque has classified all the French lakes according to their colour.

In big lakes the fauna and flora may be divided by their habitat into three classes : whether they live along the shores (littoral), or in the central regions and surface (pelagic), or in the very deep water (abyssal) ; and again, they may be divided by their habit into plankton or floating forms, and benthos or fixed forms.

In shallow waters there are no regional distinctions of this kind, and no well-marked association of forms, which can be called true plankton.

The abyssal forms have, perhaps, excited the most interest, as the conditions under which they live are the most peculiar. This region is taken to include all parts of a lake below a depth of 30 m., and it is, therefore, very feebly lighted with a low temperature, which varies only very slightly with the seasons, and is out of the influence of waves and currents. As one would expect, life is not very abundant under these circumstances.

On the bottom of the Lake of Geneva, at a depth of 80 m., Forel found what he terms an organic felt, composed of Oscillaria, Palmella, Zooglea, Pleurococcus and diatoms of various species ; the latter he supposes to be erratic and not to belong permanently to this association of forms.

It is this "felt" which covers the surface of the mud, which makes higher animal life possible in deep water, as the microphytes of which it is composed give off oxygen gas, which otherwise, owing to the stillness of the water so far below the surface, would be absent.

In Lake Constance it is said that the diatom *Cymatopleura solea* (Brébisson) occurs at a depth of 160 and 240 m.; this is a common species, and is in our Norfolk list.

The greatest depth at which a green plant has been found is 60 m., at which great depth Forel found a moss *Thamnium lemani* (Schnetzler) flourishing at Yvoire, on the Lake of Geneva. Animal life is far more numerous than plant life in the abyssal region, and Forel enumerates no less than 79 species, either erratic or permanently located, down to a depth of 110 m.; of these, 14 species are vertebrates.

Those organisms which make their home in deep water are specially adapted to their environment, and are usually smaller, paler, and feebler than their allies of shallow water. In some cases (*e.g.*, Fredericella) species, which in shallow water are fixed, live free upon the mud of deep water. The animal life of this region subsists upon the organic débris which finds its way downwards from the regions above. The pelagic fauna and flora, especially the more minute forms which compose the plankton or floating association, has been very carefully studied in Germany by Apstein and Zacharias, among others, and a large part of the work of the fresh water station at Plön has been occupied with such researches. The methods devised by Hensen for the study of marine plankton have been imported into lacustrine work, and a great deal of exact information has been collected upon the qualitative and quantitative distribution.

Most elaborate methods are used, both in making the collections and in counting the results, and this has been done not only in one lake, but in several, and at all seasons of the year; so that a good idea of the seasonal and geographical distribution has been obtained.

To show the detail into which this subject has been pursued, I show on the table a tabulated statement by Apstein of the number of organisms of different species found under

one square metre of surface, calculated for the Grosser Plöner See.

In this table you will notice that some of the figures are almost astounding; *e.g.*, it is stated that on the 31st day of July, 1892, there were about 3,811,400,000 individuals of the diatom *Fragillaria crotonensis* under 1 square m.

Of this detailed work on the abundance and periodicity of plankton, Wesenberg-Lund, who is at the head of a Danish fresh-water laboratory, says there is now no need, except perhaps for lakes, the physical conditions of which are very much out of the ordinary, and he characterises the elaborate counting work as superfluous, and erring on the side of too great accuracy; for the results give us information which from lack of knowledge in other directions we are not in a position to make use of.

He himself has studied the seasonal differences in growth of species, and finds in general that this takes one particular form, viz., a growth of the longitudinal axis and a greater development of the floating apparatus in correlation with the seasonal changes which take place in the specific gravity of water.

German writers lay stress upon the value of plankton researches to the scientific cultivation of fish; but I think more has been made of this point than is necessary, especially as the cultivation of plankton to feed the fish has not yet been suggested.

Apstein has elaborate calculations to show the weight of organic substance and ash in various species, and gives the following figures amongst others:—1 Bosmina has 0.00079 mgr. of organic substance in its composition, 1 *Diaptomus graciloides* 0.00449 mgr., 1 *Cyclops oithonoides* 0.00308 mgr., 1 *Daphnia pulex* 0.0272 mgr. He calls attention to the fact that on this calculation a fish which swallows 1000 Daphnias in a day takes in 27.2 grs. of food. Now Regnard says that a Pike devours 30 kilos. of fish to increase

its weight by 1 kilo., and a simple sum shows that to perform the same feat on a diet of Daphnias would need 1,111,111 individuals. But calculations of this kind are of little use for any purpose.

But apart from countings and calculations of this kind, the organisms which compose the plankton association, are of great interest in themselves from their structure and adaptation to their surroundings. The following classification has been made of them according to their swimming or floating apparatus:—Neidoplankton, possessing active swimming apparatus; Morphoplankton, floating in virtue of their shape (*e.g.*, needle or spindle shaped, saucer or disc shaped, or having swimming hairs or spines); Kollaplankton, surrounded with a gelatinous mass; Hidroplankton, floating by means of a secretion of an oil globule or gas vacuole; and Phlyktiplankton, possessing hydrostatic organs.

The plankton of small lakes is not quite comparable with that of large and deep lakes, as it includes a great number of forms, which in the latter are confined to the edges; Forel has given the term Heleioplankton to the association of floating organisms found in ponds.

The third or littoral region of lakes is defined by Forel as the strip of water bordering the shore down to a depth of 20 to 25 m.; *i.e.*, down to the limit of growth of green plants upon the bottom (only Chara and Nitella are found at these depths). In this region the greatest variety of life is found, and it is distinguished chiefly by its vegetation, amongst which the higher plants predominate; it merges on the one hand into the land, and on the other into the pelagic region, and partakes of the characters of both. It presents an environment much more severe than that of the other regions, because it is subject to great vicissitudes of temperature and to disturbance by winds and waves.

It will be clear from what has been said of the physical conditions of the larger lakes, which have been studied with

so much care abroad, that there is nothing comparable to the environment, which they offer to animal and plant life, to be found among the Broads of Norfolk. These have no large area of water, no great depths, are fed by no large river ; they are, in fact, mere ponds and marshes.

Are they then worth studying, or is the biologist, who spends his energies upon them, wasting his time on things that are insignificant ? They do not, perhaps, present the ideal field for a limnological research, but it is the field close at hand, and though the problems to be faced are not at first sight of so striking a kind as are those of big lakes, yet I venture to say that a study of them may not only assist towards elucidating other problems to be found elsewhere, but is of itself specially suitable for the biologist, through the very fact that the bodies of water to be dealt with are small, and varying only slightly from each other in physical conditions.

I need not dwell upon the fact that the Broadlands offer to the naturalist a field practically entirely wild and uninfluenced by the operations of man.

The minute study of a small area, though laborious, is more likely to yield real information upon the habits and necessities of life of the organism under observation, than will the study of a large area, in which the physical conditions cannot be so accurately defined.

The work for the Limnobiologist of the Broads is eminently, I think, bionomical, and it should be experimental as well as observational. Fresh water animals, unlike those of the sea, are fairly easily kept in tanks, and thus their life histories are more easily studied ; and who can say that any one species of our fauna or flora is known with such thoroughness as to make work upon it superfluous ? Of course there is still room for the work of the collector and systematist, and, as a preliminary to other work, it is very necessary that complete lists of species occurring in the

district should be made out. I am glad to say that a good beginning has been made, and besides older lists appearing in our 'Transactions,' there have been recently much amplified lists of Entomostraca, Coleoptera, Rotifera, and Hydrachnida.

Besides lists of species, it is necessary to be acquainted with the physical and chemical characteristics of each separate sheet of water, the nature of the bottom deposits, and so on.

I think the Broads offer peculiar opportunities for the study of individual species, their anatomy, physiology, and their relations to their environment and to each other.

We have already had papers read before us and published in our 'Transactions' dealing with bionomics by statistical methods, and I hope not only that this work will be continued, but that other workers may be found to take up different branches of Limnobiology and work at the same problems by different methods, and I should be very pleased if I could think that I have, by these few remarks, put before you to-night, persuaded any member that the study of fresh-waters is a fascinating one and worth spending time over. I may add that I hope to get together a museum collection at Sutton illustrative of Limnobiology, and if any member can assist by procuring specimens, I am sure that Mr. Balfour Browne, who is in charge of the Laboratory, will be very glad of his help.

I.

LETTERS FROM HAMON LE STRANGE AND ROBERT MARSHAM, F.R.S., PRESERVED AT BLICKLING HALL.

By Thos. Southwell, V.-P.

Read 26th September, 1905.

The letters from which the following extracts are taken are printed in the Report of the Historical Manuscripts Commission on the Manuscripts of the Marquess of Lothian, preserved at Blickling Hall. These MSS. passed with the Blickling estate to the Lothian family through the marriage of Lord Ancram (afterwards sixth Marquess) with Henrietta Hobart, daughter of John, 2nd Earl of Buckinghamshire. The Manor was purchased by Sir Henry Hobart of Sir E. Clere, the representative of the Boleyns in the female line, for £1100, by Sir Henry Hobart, Knight and Baronet, Chief Justice of the Common Pleas (1613—1625), he built Blickling Hall and died there on 26th December, 1625. In addition to the £1100, the sum of £500 was also paid to John Smythe of Antingham, Esq., for the purchase of land belonging to him as appears from a receipt preserved in the Blickling papers dated December 9th, 1616.

Hamon le Strange to Sir Henry Hobart requesting the assignment of a Swan-mark, etc. (Blickling MSS. pp. 82–83):—

1625. June 28th. "Hoble. The distraction of my last and short abode att London caused me to forgett a motion which I shall now recommend to your Lordship's acceptance. I understand that your Lordship hath the sole royalte from the King touching swans and swanneries in Norf., and am desirous to have a particular mark for my river and waters att Gressenhall, and else where in this countye. There is

a mark proper to Hastings formerly lords of Gressenhall and Elsinge, which is now used by Sir Anthony Browne to whom I am willing to relinquish the same, and would have a distinct marke peculiar to my name and family, and to that end I crave that your Lordship will please to afford me that favour and as speedy a grant or direction for disposing thereof as conveniently may be. I hear also that sundry stray swans are taken up betwixt Linn and me and some aieries lately erected there by meane persons. If your Lordship have not granted your power there I would desire also that additament from you." The remainder of the letter is an expression of thanks for his addition " to the number of your deputy lieutenants in Norff." Thomas Earl of Arundel and Surrey was Lord Lieutenant of the County of Norfolk from 1615 to 1642 and from his subsequent request that Sir Henry Hobart would be " aquiescent from any further motion to my Lord of Arundel for me " it is evident that Le Strange owed his appointment as deputy Lieutenant to Sir Henry Hobart's interest with that nobleman. As to the result of the application I can obtain no information. Mr. le Strange tells me that he has never found any papers in his Muniment Room at Hunstanton relating to a swan mark, and has never heard that his family made use of one. Swans have been kept by them from time immemorial; but as the swans only ranged over waters belonging exclusively to their property in the parishes of Hunstanton and Holme, there was no possibility of their getting mixed with any other people's swans and therefore no necessity for marking them. It seems not unlikely as Sir Henry Hobart died in Dec., 1625, only six months after the letter was written, that it may never have received his attention.

The Gressenhall estate referred to came to the family of le Strange by the marriage of Sir Hamon le Strange who died in February, 1579, with Elizabeth Hastings, co-heiress of Sir Hugh Hastings of Elsing of whom the writer of the letter in question, Mr. le Strange informs me was grandson; Sir Anthony Browne who used the Hastings' swan mark was descended from another co-heiress of Sir Hugh Hastings.

Why Sir Henry Hobart as Chief Justice of the Common pleas should have it in his power to grant a Swan Mark is not apparent, but it might be owing to a special grant from the King which would probably be revealed by searching the Patent Rolls preserved in the Record Office.

The following agreement between Sir John Hobart and John Swann for the purchase of Swans is interesting as well for the price paid as the localities whence the Swans were collected and seems worth preserving. It is derived from the same source as the above.

AGREEMENT FOR PURCHASE OF SWANS
BETWEEN SIR J. HOBART AND JOHN SWAN
OF SAXLINGHAM, NORFOLK (l. c. p. 124)

1674, OCTOBER 24.—That the said John Swan in consideration of the sum of tenne pounds of good money of England, five pounds part whereof the said John Swan doth hereby acknowledge to have received and had, hath and doth oblige himself his executors and administrators to deliver and cause to be delivered to the said Sir John Hobart or his assigns thirty and fower swans at Midsomer next or within 14 days following, upon the delivery whereof the said Sir John Hobart is to pay or cause to be paid to the said Jo. Swan or his assigns remaynder of the said tenne pounds. In witness wherof I have herewith set my hand this day and year above mentioned.

(Signed) JOHN SWAN.

Witness.
THOS. SEABOURN
JO. BREWSTER

Then follows :—

A note of what swanes I marked that was boute of John Swane.

Imprimis at Langley marse one swane.
Item boute there a land birde.
Item at Hasingham Litteldike one swane
Item at Harsinghame greete dike one swane
Item at the diveles house one swane.

Item at Strumshote fen one cocke and one signet.
Item one swane more there.
Item at the Lower fenedike two swanes.
Item at Brindall house one swan.
Item at Sullingham fery one swane.
Item at Sullingham one cocke and three signetes.
Item at Possicke halle 2 swanes.
Item Wickelingam one cocke and 3 signtes.

Robt. Kemp's note of Mr. Swans of Saxlingham.
Swans upped in the year '75

Imprimis at Bintry Common one swane.
Item at Grente Mille one swane.
Item against Belowe Church one swane.
Item at Linge mille one hene and one signett.
Item at Prates Mille one swane.
Item at Warden medowes twoe ould swans
Item above White mille three swanes
Item at Cossye blakewater 2 swane
Item at three briges one swane.

Robert Kemp his accompt of the swanes
bought of Wynter.

ROBERT MARSHAM, F.R.S. (1708–1797), ON ARBORICULTURE.

In the Introductions to Mr. Marsham's "Indications of Spring," published in our Transactions, vol. ii. p. 32, will be found some interesting particulars as to the treatment of the trees on the Stratton Strawless estate by that remarkable man, with farther information on the same subject in his letters to Gilbert White of Selborne, at pp. 133—195 of the same volume; Mr. W. G. Clarke also contributed to our Transactions (vol. vi. p. 552) a contemporary notice from the 'Norwich Mercury' of 22nd Nov. 1777, recording the result of some experiments suggested by Evelyn and Dr. Hales and carried out by Mr. Marsham on certain Beech trees at Stratton, by which their growth was increased to almost double that of those not subjected to the same treatment, and I wish now to call attention to two letters from

the same to the Earl of Buckinghamshire on his treatment of Oak trees, especially with regard to his method of lopping. The letters are dated November, 1777, and show still farther his great intelligence and love of his favourite pursuit. His remark, "I love them as my children," is worthy of his correspondent Gilbert White, and justifies the esteem in which the latter held him.

The extracts are from letters addressed to John Hobart, second Earl of Buckinghamshire (1723—1793), second son of John, first Earl; he was M.P. for Norwich in 1747 and 1754, and succeeded to the title in September, 1756; was Ambassador to Russia from 1762 to 1765, and held the post of Lord Lieutenant of Ireland from 1776 till 1780. He died at Blickling on 3rd September, 1793, aged 70 years.

Robert Marsham, F.R.S., to Earl of Buckinghamshire. Stratton, 12th Nov. 1777. (Blickling MSS., p. 322).—Marsham after complimenting his Excellency on his speech to the Irish parliament and thanking him for "favours" received, regrets that he has little provincial news to communicate and goes on to say "News, however, may be without reaching my ears, as I am rooted down here like my trees: with this difference only, that the spring gives no new life to me. I have been removing some of the dead trees by the road side, between Blickling and Norwich, and when you return, 'to join the dignity of life with ease,' I hope growing trees will show themselves. My Lord it is not confin'd to Ireland that trees grow too thick. I never yet knew any man that planted a grove, that could thin it enough. I feel it for my self, and see it in all others. I remember a very large and fine wood in the High-land of Scotland (I think Lord Kinnoull's) so thick as to deprive them of heads, and the Duke of Portland's (according to the new Evelyn) *must be all spoiled*."

R. Marsham to the Earl of Buckinghamshire. (Blickling MSS., p. 323. Fragment undated).—"I know trees ought to be removed as soon as they whip each other with a moderate gale; but I love them as my children, and

I cannot act with my own judgment. So I have taken a method of my own. If a tree is 50 feet high, I take off 6, 8, 10, or 12 feet: and then leave the uppermost branches a foot from the stem: the next floor of branches I leave half a yard or 2 feet long, and so downwards, leaving them longer. By this means I leave the headed tree in its natural shape, and inable it to receive the same advantage from the rain and dews as it had before. This prevents its whipping its neighbours which should be the better tree; and I flatter myself, the headed oaks may stand till they are worth 2 guineas a tree, with very little harm to the grove. They also throw out thick heads, which I hope will prevent the best trees from throwing out a great many lateral shoots, the common consequence of thinning too much at once by letting in too much air amongst them. Let me recommend this method to your Excellency. The only reason I know against it is, the headed trees will not increase so much in the stem as those untouch'd. But I had one that gained an inch this summer, and I hope every year they will suffer less than the first, and if they may stand till they are worth 2 guineas, instead of 5s., and the grove appear thicker at a distance, I am a gainer. But 'tis at present such a favourite hobby horse that I believe the headed trees will become in time both as good and handsom as if they were left to nature. . . . .

P.S. My Lord, an oak I planted in 1720 is this autumn 83 feet and ½ of timber in the body; measuring bark as timber. I believe very few persons under 70 years old can say so much; but I wish your Excellency may say it in time."

NATURAL HISTORY

FRUIT HEADS OF STRATIOTES ALOIDES, 24th ix. 1905.

See page 200.

II.

STRATIOTES ALOIDES, L.

By Alice M. Geldart.

Read 28th November, 1905.

On the occasion of the excursion of this Society to Sutton (E. Norfolk) on the 21st of June last, our attention was drawn to plants of *Stratiotes Aloides*, then in flower. The ovary of one of the plants was already swelling and had turned hard; this led to discussion, as the female plant only is known in Britain. I asked Mr. Arthur Bennett, F.L.S., for information. With much kindness he replied (in litt.), "I am sending you Nolte's classic work on Stratiotes which may interest you. Keep it as long as you like, perhaps you would like to show it at one of next Session's Meetings. Stratiotes is not one of the species I propose to write." Mr. Bennett says that he has never seen the fruit, and had no opportunity of studying the plant *in situ*. Mr. Nicholson asked me to show Nolte's book this evening, and suggested that further notes and diagrams would be acceptable, with some account of the plant as Nolte represents it.

Dr. Ernst Ferdinand Nolte, Professor of Botany at Kiel, was occupied for several years in compiling a Flora of the Duchies of Holstein and Lauenburg. Intending to issue separate original treatises on some of the native plants, and to incorporate only the final conclusions in the Flora, he was particularly attracted to the Water Plants, and combines *Sagittaria sagittifolia* with *Stratiotes Aloides* in this book. He studied Stratiotes in Lauenburg during the summer of 1824, worked at Copenhagen during the following autumn and winter, and published the book there in 1825. I am only dealing with the part that refers to Stratiotes.

I have also been able to study two books borrowed from the Library of the Linnean Society, through the kindness of Mr. J. H. Gurney, F.L.S. The 'Botanische Zeitung' for 1860, p. 81 and 82, containing Klinsmann's account of his discovery of the germination and seedlings of Stratiotes of which he gives three illustrations (taf. ii. A, a—c), and pages 81 to 91 in 'Flora,' 1865, giving Irmisch's further study of the same subject, and figs. 1—20 in taf. ii. Klinsmann (1860) was so well satisfied with Nolte's detailed account that to make any special addition to it, or to discover faults in it, he says, would be like looking for the needle in the bundle of hay.

The first mention of the plant is by Dodonœus, in his 'Kräuterbuch,' written in Dutch, 1553, under the names Stratiotes potamios and Sedum aquatile. Called Stratiotes Aloides by Linné, 1753 (Sp. Pl. 535) it is also known as Stratiotes foliis aloës, semine longo (Raii Syn. 290).
Stratiotes aquaticus (Dalech. Hist. 1061, f.).
Militaris aizoides (Ger. Em. 825. f. Lob. Ic. v. i. 375. f).
Aloe sive Aizoon palustre (Bauh. Hist. v. 3. 778. f.).
Yucca palustris septentrionalium (Tillands).
Aloefolia palustris (Plukenet).

In France it is Stratiote aloès; in Belgium, Faux-aloès, Valsche Aloës; in Germany, Wasserfeder, Sickel or Sichelkohl, and Aloeblättrige Krebsscheere. The name in S. Germany is Scheeren, from the spathe which resembles crabs' claws.

In Johnson's edition of Gerard's 'Herbal,' 1633, its English names are given as:—Water houseleek, Knights' pondwort, Knights' water sengreen, Freshwater soldier, Wading pondweed, Soldier's yarrow, Knights' water woundwort.

It is called Water-aloe by Petiver (c. 1657—1718), and Water Aloe or Freshwater Soldier by Hudson in 'Flora Anglica,' and Sir James Smith in 'English Flora.' Its local name in Central Cheshire is Water Pine.

Old records of *Stratiotes* must be accepted with caution, for *Achillea Millefolium* is "*Stratiotes millefolia*" in Fuchs' Hist. (1542), *Hydrocharis* is called *Stratiotes foliis Asari semine*

rotundo in Ray's Synopsis (1690), and some commentators have mistaken *Sagittaria* for it (Smith's Eng. Fl. vol. iii. p. 35). Klinsmann says that the name is also applied to some *Umbelliferæ*; and Vaillant applies it to *Hottonia*.

STRATIOTES ALOIDES IN BRITAIN.

The male plant is unknown in Britain. An illustration of the male flower was added by Dr. Boswell Syme in the 3rd ed. of Eng. Bot., but he mentions that he had not seen it in British specimens.

The female plant occurs in Suffolk, Norfolk, Cambs, Hunts, Northton. N. Lincoln, Notts, Chester, S. and W. Lancs, S.E., S.W. and M.W. Yorks, and Northumberland (Top. Bot. ed. 2 and Suppt., 1905). It has been introduced into several other counties, *e.g.*, I. of Wight, Oxford, Leicester. Near Abingdon (Berks) it is increasing fast (G. C. Druce, in litt.). Stratiotes is not mentioned in Turner's Cat. of Plants (1596—99) nor in his Libellus de Re Herb: Nov: (1538). The first record for England is in Johnson's edition of Gerard's Herbal (1633):—"*Militaris aizoides*. Fresh Water Souldier. I found this growing plentifully in the ditches about Rotsey, a small village in Holdernesse, and my friend Mr. William Broad obserued it in the fennes in Lincolnshire."*

How's Phytologia Britannica (1650): "In the new Ditches of the Dutch workes at Hatfeild."

Sir Thomas Browne in 'The Garden of Cyrus,' 1658:—"The like in fenny seagreen, or the Water Soldier, which though a military name from Greece, makes out the Roman order." The arrangement of the leaves in this and some other plants he supposed to be "defensative against lightning and thunder."

In Gough's Camden (1789):—"In most of the broads down the two rivers leading to Yarmouth and at Acle."

In the Flowering Plants of Harleston, the Rev. F. W. Galpin:—"formerly frequent, now rare"; see his account of its increasing rarity in the Waveney Valley, p. 29.

* 'Journal of Botany,' vol. xxxii. (1894), p. 342.

In Northants *Stratiotes* first recorded by Ger. Morton (1712) as *Militaris aizoides* from Peterboro' in the fen ditches (G. C. Druce, Fl. of Oxfordshire, 1886, and Fl. of Northampton, p. 120); is probably now extinct in that County. Near Cambridge it is plentiful. It occurs in all divisions of Suffolk except Sudbury (Hind's Fl. p. 327), but in only one locality in Essex (Gibson's Fl.). Suffolk and Cambs form the Southern limit of native localities in Britain.

H. C. Watson wrote in Comp. Cyb. Brit. (1870), "certainly wild in the Eastern provinces of England"; but later (Top. Bot., 2nd ed. 1883, p. 408) "extremely difficult to separate the artificial from the natural stations for this plant, if any of them are absolutely native localities for it. I have seen it in the province of the Mersey only, and distrusted all the few localities where observed. The province of Ouse seems the most deserving of trust."

In Scotland the female plant has been naturalized at Corstorphine, Duddingston Loch, Loch of Clunie, and Forfar Loch; see Mr. R. S. Wishart's account in Trans. Nat. Hist. Soc. of Glasgow, vol. vii. New Series, pt. i., 1902–3, p. 115.

In Ireland it is very local and probably not indigenous. Possibly native in the N. of Ireland. Thoroughly at home in the lakes and ditches of Cavan and Fermanagh. (Cybele Hib. Moore and More. 1866.)

GEOGRAPHICAL DISTRIBUTION.

Essentially an inhabitant of still water not exceeding a few feet in depth, Stratiotes is found in the Pyschma River in W. Siberia, and in "all countries of Europe except Greece" (Hook. Stud. Fl.); but I can find no record for Switzerland where the elevation is probably too great. According to Nolte, only the *female* plant is found between 68° and 55° N. Lat. in Europe, this zone extending 2° further S. in Britain; from 55° to 52° *both sexes* occur; S. of 52° in W. Europe, only the *male* appears; S. of 52° in E. Europe, the *female* plant is much rarer than the *male*. The most northern locality is Ofoten (68°) in Norway; in Russian Lapland it occurs in the

Kemi River at 67½° ; and in Sweden, though rarely flowering, the female plant goes as far N. as 61°, occurring in 10 provinces. In N. Europe it is so abundant that, like Hydrocharis, it is used for manure. In Denmark, Stratiotes is always female. Both forms occur in Holland in special abundance ; also at Danzig, Bremen, Luneberg, in Oldenburg, Westphalia, Holstein, and Brunswick, at Lauenburg and Wittenberg on the Elbe, Barby, Königsberg, several places in the neighbourhood of Berlin, at Mechlenburg, and at Grodno in Russia. According to Bergen the female is very rare at Frankfort on the Oder, but the male is predominant. In Brabant and Flanders, Roucel found only the male plant, no matter how carefully and often he looked for the female. The male plant occurs near Bordeaux, the only locality for Stratiotes in France. Found in Austria (R. Danube), Moravia, Hungary, Transylvania, Finland and nine provinces of Russia, Stratiotes does not appear S. of 40° N. Lat., its southern limit being Catalonia (Spain), Mantua (Italy), Servia, Rumania, and the Caucasus. Its northern limit of distribution corresponds roughly with the isotherm of 32° Fahr. during March, April, and May, when Stratiotes is rising ; and the same isotherm in September, October, and November when the plant is sinking in the water.

STRATIOTES AS A FOSSIL.

Mr. Clement Reid records (Origin of the Brit. Flora, 1899, p. 153, etc. ; Trans. N. & N. Nat. Soc., vol. v. page 382, vol. vi. p. 328) that *fossil seeds* of Stratiotes have been found in the preglacial deposit of Cromer Forest-bed, at Beeston and Sidestrand in Norfolk, Corton in Suffolk, and a single specimen in the interglacial bed at South Elmham ; also at Fahrenkrug in Holstein, and abundantly in the probably interglacial bed at Klinge bei Cottbus, near Berlin.

In a letter received from Mr. Clement Reid last October, he says :—" Only the detached carpels are found fossil—not the whole fruit. All my fossil specimens were apparently fully developed and ripe, some looked as if they had germi-

nated. The plant is fairly common in a black peaty seam at the foot of Beeston Cliff, but elsewhere is rare. I have no new localities to add since my book was published, and the fossil seeds seem to be confined to Norfolk and Suffolk."

LIFE HISTORY.

After the plant has gone off flower in August, a vertical section of the lower part shows that all the leaves lie pressed round one another, decreasing in size towards the centre (Nolte t. i. figs 2 and 4). They spring from a thick fleshy body, somewhat concave on the upper part, 1 to 1½ inches across, and 4–6 lines high, showing in the interior a yellowish somewhat concave roundish mass of faintly striated tissue; outside this a whiter looser mass, the two separated by a layer of thickened cell-tissue. Nolte calls this rootstock a bulb; it is now considered to be an abbreviated stem. The leaves surrounding this body are each separately enclosed at the point of attachment by close-fitting small whitish membranous scales, so that, if one breaks off all the leaves carefully at their base, the rootstock appears occupied by numerous small chaff-leaves (Nolte, t. i., fig. 5).

The fleshy body only protrudes rootfibres on the under part; the roots springing directly from the inner mass. They are quite simple, very long, cylindrical, some lines thick, smooth, soft, and white. In Norfolk specimens, the rootlets when first protruded and until at least an inch long, are sometimes bright green, a section in such cases showing that this colour encircles the yellow rootlet before it emerges from the rootstock. I have seen on Rockland Broad, fullgrown submerged plants late in December with green rootlets an inch long, evidently protruded late in the season, the long white roots being rotten or having fallen off. Johnson (Ger. em. 1633) says :—" instead of roots there be long strings, round, white, very like to great harpstrings or long worms which falling down from a short head that brought forth the leaves, go to the bottome of the water, and yet be they seldome there fastned." On the lower part they are bordered with very

delicate, white, transparent offstanding filaments which, soon after they are taken from the water, collapse and wither away; they are probably the vessels of absorption. This part of the root is well figured in Ger. em. p. 825. Winter records ('Phytologist,' 1861, p. 154) "in ditches near Ranworth its roots were seen 3 feet deep in the mud, and 6 feet long."

A sprout of leaves appearing in the centre of the upper surface of the rootstock is followed in succession by several similar sprouts. Nolte says that the object of the sprout of leaves seems to be not only to cover and separate the new growing buds, but also to support the plant in equilibrium when floating, otherwise it would be drawn down into deep water by the decay of the outer leaves which suck themselves full of water.

Around the central mass and in the white fleshy part lie many longish small germs (Nolte t. i., figs. 2 and 4) which, gradually swelling with the growth of the plant, protrude with a pointed end and develop into stalked buds. Growing out between the leaves on their stalks, these buds are longish-lanceolate, acute, in transverse section bluntly triangular, ½ to 1½ inches long. The stalks are cylindrical, somewhat compressed, surrounded at the base by a membranous keel-shaped folded sheath. The vertical section of a bud (Nolte, t. i., fig. 6) shows that on the outside it consists of closely superposed, obtuse, entire-edged, thick-skinned scales which enclose a crowd of sharply serrated leaves, lying thickly round one another. On the base of this bud where it is joined to its stalk, there is a roundish thickening and immediately above this a slight constriction; this thickening has a smaller somewhat differently coloured inner mass, around which on the upper side lie singly minute roundish germs, which in the further progress of the plant develop into new buds. Pointing downwards, and more on the under part of the external fleshy mass, lie small cylindrical germs which afterwards grow into roots. Each of these buds is formed just like the mother plant, and is capable of growing into a perfect plant.

In autumn the plant sinks down apparently urged by the approach of frost, and hibernates lying on the mud, where

it rots away, only the rootstock with its leafsprout remaining. In 1905 the plants at Rockland Broad had all sunk, by September 17th, in 3 to 5 feet of water.

If in autumn the plant be forcibly torn from its attachment, or if its power of germination be exhausted, it becomes loosened from the ground, often finally clinging by a single thread, and as soon as this also withers, the plant turns upside down, floating, rootstock uppermost and leaves inverted, until it rots away entirely. If such forcible destruction does not take place, the central body hibernates, and the leafsprout germinates again next year. In winter condition the rootstock assumes a more even shape; the whole mass is more compressed and more solid; and germs prepared for the next growing period become evident.

Nolte says on page 5, that meanwhile some of the earlier-mentioned buds have been formed by lengthening of their stalks into new stolons (Nolte, t. i., fig. 1). With these buds the plant, *towards the end of August*,* again raises itself to the surface of the water, these buds push out rootlets at their bases, become gradually larger and try to reach the ground. As soon as the rootlets lay hold of it, the buds separate themselves from the mother-plant by decay of the former budstalk or runner, and attain to independent existence. Is "*August*" a misprint for "*April*"? The sentence follows immediately on Nolte's description of the winter condition of the plant. Was Kerner quoting from this passage? in saying (Oliver's edition, vol. i. p. 76) :—"When the time of flowering is over the plant sinks again to mature its fruit and seeds and develop buds for the production of young daughter-plants. *Towards the end of August* it rises for the second time in one year." Does it do so in England? In answer to my question, Mr. Spencer Bickham, F.L.S., who grows Stratiotes in a pond at Ledbury (Herefordshire), writes (in litt.), "It does not do so here. About May it can be seen rising, but often partially sinks again before rising fully and flowering. I may be wrong but I have imagined the temperature of the water

* Mit diesen Knospen erhebt sich die Pflanze gegen das Ende des August's wieder zur Oberfläche des Wassers.

had to do with its reluctance to rise rapidly. About the end of August or at any rate before September 15th. it sinks and does not reappear until the following year." To return to Nolte :—This increasing continues into the late autumn, indeed often till December. The young plants then pass the winter on the mud. Even buds which are accidentally detached, provided that the rootstock is uninjured. can maintain themselves floating, push out roots, and later become new plants. These develop from closed buds often at first only ½ an inch in size. Nolte cultivated in his room several of these young plants 3–4 inches in size, during the winter 1824–5.

The increase of these buds is very rapid. Lord de Tabley records that " 6 specimens put into 2 ponds became 80 plants in 2 years." This is the only mode of increase in England, as perfect seed is at present unknown here. Even in localities on the Continent where both sexes occur, rootbreeding seems to be the chief method of increase ; where this predominates the formation of seed is hindered.

After hibernation the plant rises again to the surface in April or May and floats on the water, pushing new roots out of its base, and leaves out of its upper surface. From the end of June or beginning of July till August it develops flower heads and often covers whole surfaces of water with its beautiful flowers. If young plants appear now between the leaves, they will not develop yet ; one frequently finds a flowering plant with young plants 3 to 4 inches in size still attached by runners ; they appear, however, to be inactive.

The peduncle, in specimens at Sutton about 4 inches long when the flower expands, lengthening to 6 inches as the fruit forms, is surmounted by a membranous, two-leaved spathe ; its leaflets boat-shaped, sharply keeled, the keels bordered with sharp little teeth directed upwards, persistent. Nolte says that these leaflets are 1 to 1½ inches long, almost equal. At Sutton one leaflet is always decidedly larger than the other, the longer one measuring up to 1⅝ inches ; a few of these spathe-leaves I found to be hooded ; quite closed at the upper end, the larger one more so than the other. In both male

and female plants the spathe is gibbous on one side, this is therefore the true shape of the spathe and does not depend merely on the presence of the unequal pedicel bearing the fruit, as might be supposed from British specimens. Fig. 1 represents a spathe with a double keel, unlike any other I have seen; it also shows the flat and gibbous sides of the spathe.

The male plant (Nolte, p. 29) has 3–6 flowers springing from the common spathe. Each pedicel is encircled by a separate one-leaved, membranous sheath, like a leaflet of the outer spathe, only smaller. The flowers 1–1½ inches in diameter, open in succession. Each cylindrical, semitransparent pedicel, bent S-shaped in the sheath, gradually straightens and lengthens till 2–3 inches long. The calyx consists of one leaf, 3-lobed, erect; each lobe ½–¾ inch long, ovate-lanceolate, bluntly rounded, and drawn together hood-shaped at the top; at the base, greenish-white, shining, semi-transparent. The lobes form on the under part a blunt triangle, then turn upwards again. The corolla has 3 petals, obovate, suborbicular, somewhat converging at the upper edge, milk-white with many transparent narrow stripes which converge at both ends and continue for the whole length of the petal. The petals are alternate with the sepals. The nectary (according to Nolte) consists of a circle of 15–24 yellow, rather compressed, subulate rays rounded off at the upper end, spotted on the surface with darker yellow, of somewhat leathery substance, and without any partitions inside.* They are attached at the base to short very attenuated white stalklets and surround the stamens in a circle. The stamens vary from 12 to 25. The filaments are subulate, compressed, erect, whitish, sometimes dotted, surrounding the centre of the flower without definite order.

The female flower is almost similar to the male externally, but rather stouter and stronger. The spathe contains only one, rarely 2 flowers. Nolte says that each flower is also

* The question how far Stratiotes is entirely or imperfectly dioecious being still under consideration, I have followed Nolte in calling this part the "nectary"; many Botanists think that in the female flower it consists of abortive stamens, see page 197.

enclosed in a special inner sheath. In some Sutton specimens I have found two of these inner sheaths, in other flowers only one, and frequently none ; these variations taking place on the same plant. They seem in the Sutton flowers to be attached at the base of, or just below the ovary, and separated from the spathe by the pedicel. The calyx as in the male but somewhat more closed and broader, petals inclined to be obcordate, rather smaller and more closed than in the male, but displaying the same converging lines. The rays of the nectary (according to Nolte) are similar in number and constitution to those of the male flower, but somewhat larger, nearly half as long as the calyx. The ovary with its pedicel is much shorter and thicker than the male pedicel, so that the flower does not project far beyond the spathe. The six styles are thick, fleshy, three edged, erect, each passing gradually into the two, likewise three-edged, spreading, stigmas which are velvety on the inner opposite surfaces.

The original drawing for the illustration in Eng. Bot., 1445, has the following note by Sowerby. "W. Skrimpshire, of Wisbeach. Plentiful in ditches at Outwell between that place and Downham, Norfolk" (Notes on Drawings for Eng. Bot. Suppt. to J. of Bot. 1904, p. 204). The illustration dated March 1, 1797, represents a plant having only one short-stalked flower in evidence, whereas the plants at Sutton bear fruit in early stages of development at the same time as the open flower, and a series of buds preparing to open in succession. At the foot of the illustration, the figure of one segment of the perianth with styles and nectary (? imperfect stamens) shows the segment uncoloured in Ed. i. : in Ed. iii. it is green, but, judging by its shape and position, I think Sowerby intended it for a white petal not a green sepal.

The specimen which I brought from Sutton on June 21st, was remarkable for having all parts of the flower arranged in twos instead of threes. The flower buds in various stages of development, as well as the open flower, had 2 sepals, 2 petals, 4 styles, ovary in 4 segments.

Nolte says that in districts where *both sexes* occur, when the fruit is quite ripe the pedicel bends out between the spathe

leaves towards the gibbous side of the spathe; the fruit gradually forming a right angle with the stalk. In districts where *only the female* plant occurs, the fruit remains erect in the spathe or protrudes only a little with a slight inclination (Nolte t. i. figs. 7, 8, and 13). Yet the latter, Nolte thinks, is much more rarely the case, for among some 80 fruits which he found at Copenhagen only 8 or 9 were bent.

It is different at Sutton. A specimen gathered there on July 7, 1905, shows that even so early in the season the fruit begins to bend soon after the flower withers. At that date, plant after plant, in some cases every flowering plant had bending fruit, and Nolte's 10 % seemed to be already exceeded. Can it be that at Copenhagen the pedicel does not develop so readily as in England? In Nolte, t. i., figs. 7 and 8, the pedicel is much shorter than we see it. At Sutton the pedicel alters in shape though it does not seem to increase much in length after the flower falls. In one of the figures of detail in Eng. Bot. the pedicel seems to be just as much wanting as in Nolte's figures.

Among specimens of fruit brought by Mr. Nicholson from Sutton on Sept. 25, I found a young fruit still erect showing clearly the joint of the pedicel (figs. 2 and 3). The inner sheath was entirely wanting. One side of the pedicel at the joint was loosely folded, and it is evident that if this fold were inflated the pedicel not having a corresponding fold on the opposite side must bend. I had observed that the integument on the under side of the pedicel is not wrinkled when the joint bends, but this is the only specimen in which I have noticed the actual fold on the upper side. I cannot find any description of it. It looks as though the inflation of the pedicel must force the fruit to bend over; or is it the pull of the fruit that forces the pedicel to bend?

Irmisch says that, when at his request, his friend Herr Klinsmann sent him ripe seed of Stratiotes late in October, 1861, the completely ripe fruits had protruded themselves with their short thick pedicels between the 2 spathe-leaves, some being bent perpendicularly downwards, and some standing off from it crooking themselves somewhat upwards

(Irm. figs. 1 and 2). In the latter case only a few seeds had come to full development, in the earlier case more. Irmisch considered that on this the difference among the fruits in form, dimension and direction may well be based.

The fruits at Sutton in September did not bend more than my sketch (figs. 4 and 5) represents, for though they had bent so much as to tear away parts of the spathe-leaves, the peduncles were hanging straight down below the plant, nearly rotten and quite limp. I have in fact painted these specimens wrong way up. I have not ascertained why the fruit bends. Mr. Bennett suggests that it may be a question of buoyancy; neither do I know yet whether the fruit enters the water by bending of the peduncle before the plant sinks. After sketching these fruits I dissected them, and found the seeds minute and quite undeveloped.

At Copenhagen in November and December, 1824, Nolte found Stratiotes abundant under the water, apparently with the most beautiful fruits, some of which had large seeds to the outward appearance perfectly developed; yet on closer inspection it was found that only the cuticles were perfect, they even contained only a part of the inner mass. In Seeland only the female plant is found; this is therefore what we may expect in England.

The capsule which from the first takes the place of the long pedicel of the male flower is ovoid, diminishing at both ends, bluntly hexagonal, two of its angles usually more prominent and provided with sharpish prickles on the edges, otherwise glabrous. After the flower has withered the upper part of the fruit terminates with 3 blunt teeth, from the centre of which a small conical body protrudes to which the styles are attached, and at the extreme point is 6-cleft. The husk of the fruit is thick and leathery, enclosing a fleshy layer from whose inner surface 12 fleshy extensions stand out like partition-walls arranged in pairs, and run together towards the centre without being fastened either to one another or to a central column. In the young state these extensions wind round one another at the edges and form 6 false compartments with partition walls wound spirally. The pairs of these extensions are

situated opposite the outer facets, accordingly alternate with the ridges. At the lower end they run into the fleshy layer of the pedicel, but at the upper end terminate with 12 points which, standing in pairs, make the cone apparently 6-cleft at the top. Nolte says that if a longitudinal section of the fruit be made and a cross cut taken out of the middle part, these extensions can be unfolded, so that the apparent compartments of the fruit can be divided without artificial separation (Nolte, t. i. fig. 11). The fruit is described by many authors as a hexagonal berry or capsule in which these partition-walls are said to be grown together in the axis of the fruit, which Nolte thinks is by no means the case. Moreover, he says, each pair of these false partition-walls or extensions is the attachment joint of a style, the styles accordingly alternate with the compartments of the fruit. Irmisch says that the partitions, free from one another in the centre and at the sides, appeared to him to be closed in the angles, not open as Nolte describes them.

In the Sutton plants in September the seeds are yellow, the compartments and walls of the fruit are a rich orange, the outer integument dark brown, the whole filled with clear white mucilage which surrounds the seeds. The fruit as it develops becomes irregularly lobed. Nolte says there are usually 5–6 seeds in each compartment, accordingly 30–36 in each fruit, but he adds that even in localities where the plant perfects fruit, all the seeds are seldom fertilized, usually only 2 in each compartment. They are attached in the outer angles which the extensions form with the fleshy layer ; the seeds are alternate, anatropous, not pendulous.

When the flowering period ends and fruit is forming the whole plant goes again under water, there ripens fruit which ruptures by decay in the water, bursting irregularly, and the seeds covered by viscid mucilage are strewn on the ground (Hooker's ed. of Le Maout and Decaisne's Desc. and An. Bot. 1873, p. 757). Simultaneously with the ripening of the fruit the growing buds develop on their stalks between the leaves.

Klinsmann says, in N. Germany Stratiotes is such a common plant that it infests ditches and pools as a troublesome weed,

increasing quickly by runners and by many Hybernacula which, sinking into the depth of the mud, are not destroyed even in the most severe winter. The female plant, much rarer than the male, indeed almost absent from many localities, bears ripe fruit still more rarely ; perhaps the fruit is frequently overlooked on account of difficulty of access in deep ditches, and because the fruit does not ripen completely till late in October. For several years Klinsmann failed to observe the germination of the seed because the seeds were gathered in August, and accordingly unripe. In October, 1858, he found ripe capsules, took them through the winter in a glass of water mixed with muddy earth, and in May, 1859, obtained the first seedlings. Irmisch kept his ripe seeds constantly in water ; most of them germinated in the course of the next spring and summer (1862), others in 1863, some not till the Autumn of 1864. Klinsmann had a similar experience. Klinsmann points out that Gärtner has represented the fruit quite correctly in his "de Fructibus et Seminibus, tab. 15," but that the seed belongs to Sparganium. According to Nolte the seed is 2 lines long, 1 line thick, but Klinsmann says that Nolte represented them too small.

Lord Avebury made no original research as to the germination of Stratiotes, but in his work on "Seedlings" (vol. ii. p. 559) gives a description of the seeds, embryo, and germination, derived from the accounts of Klinsmann and Irmisch ; he makes no mention of the position of the fruit in relation to the peduncle nor of the distribution of the plant.

The root does not emerge till some weeks after germination has commenced. Kerner says (I. p. 752), "The primary root produced from the seed of the Water Soldier is embedded in mud, and is therefore really a subterranean root ; after it has died off the whole plant rises up, remains oscillating below the surface of the water, and develops floating roots from its abbreviated leafy stem ; later the plant again sinks down and the floating roots again become subterranean."

I can find no statement as to the method of fertilization in Stratiotes—probably it is by some winged insect. At Sutton we noticed, in July, two or three little black flies

inside at least 80 % of the expanded flowers. Withering says (Arr. Brit. Pl. ed. 7. vol. iii. p. 668) the plant is sometimes quite disfigured by the depredations of insects. *Bagous binodulus* feeds on this plant in France; and Linné noticed the larva of *Phalœna stratiotis=Paraponyx stratiotata* on Stratiotes; for an account of this caterpillar, see Prof. Miall in Nat. Hist. of Aquatic Insects, 1903. p. 231.

In chap. 4 Nolte describes the literature relating to Stratiotes. Before 1824, the plant had been declared dicœcious by Zinn, Bergen, Fabricius, Oeder, Scholler, Roth and Ehrhart, and although they gave complete descriptions and illustrations many people appeared unwilling to deviate from Linné's explanation, and still took Stratiotes to be polyandrous; to which opinion Miller and Smith appear to have contributed much.

Smith in Eng. Bot. 1797, and in Flora Brit. 1800, represented the plant in the Polyandria. He says in Eng. Bot. ed. 1., "Linnæus in his manuscripts quotes Bergen, Zinn, and Fabricius as having found the flowers dioicous, whereas he always observed them to be hermaphrodite. We have seen the stamina, apparently imperfect in some flowers, and the styles in others." This is not quoted correctly by Nolte who makes out that the "he" is Smith,* whereas the "he" is Linnæus, and Smith includes himself in the "we" of the following sentence. The words "Flores abortu plerumque dioici" in Flor. Brit. 2, p. 580, are pointed out by Nolte, but he omits the "pedunculi uniflori" of the preceding sentence. In Eng. Flora, vol. 3, p. 35, 2nd ed., Smith says: "the anthers are occasionally imperfect in one flower, the stigmas in another, whence some curious but superficial observers have thought the flowers dicœcious; but such casual imperfection in those parts is frequent in plants that increase much by root." I cannot find that Smith mentions Nolte's book.

Nolte points out that in Hooker's 'Flora Scotica' (1821, p. 171) the plant is again represented as hermaphrodite, Hooker remarking that "sometimes the flowers are dicœcious,

* Nolte, p. 26, 27:—"allein er (Smith) habe sie immerals Hermaphrodit beobachtet."

and sometimes the stamens are on the same flower with the 5- or 6- cleft styles."

Nolte explains three views, viz :—

1. Linné's, according to which the plant is only hermaphrodite.

2. Zinn's : only diœcious.

3. Gärtner's : polygamous, *i.e.*, hermaphrodite and also bringing forth male flowers.

According to Nolte, Zinn's opinion is the only right one.

Nolte considers that the parts which Linné took for true stamens cannot be either perfect or imperfect stamens, but must be regarded as a much-rayed nectary, as Roth and Richard had already remarked. Nolte's ground for his opinion being that :—

1. These rays consist of a homogeneous somewhat fleshy mass which shows no sign of a loculament.

2. They contain no trace of pollen.

3. According to C. K. Sprengel's observation, each stalklet which supports a ray, exudes a moisture (honey) on the outer side.

4. These rays always enclose the outermost circumference of the fructification parts and are strongly separated from them by their circular or annular attachment.

5. One never finds a transition in the male flower from these parts to a true stamen ; the two parts never occur mixed together. On the contrary, the inner parts of the male flower possess the form, loculaments, and pollen characteristic of true stamens.

Lord Avebury seems to adopt the German view, saying that the plant is diœcious, and that both male and female flowers have honey.

Nolte's opinion being so much opposed to Sir James Smith, Sir J. D. Hooker in the 'Student's Flora,' Sir W. J. Hooker and George Arnott in their 'British Flora,' W. A. Leighton (Fl. of Shropshire), Dr. Boswell Syme in Eng. Bot. 3rd ed., and Withering (whom Nolte does not mention), I was anxious to read Klinsmann and Irmisch who, as we have seen, uphold Nolte generally, though they do not discuss the structure of the flower, and neither they nor Nolte illustrate the flower.

I wondered how far our British Botanists might have followed Linné without examining the plant for themselves. Only this morning (Nov. 28, 1905) I received a letter from Mr. A. Bruce Jackson in which he says :—" I first met with Stratiotes in 1900, when I found a small pond near the water-works at Sandown, full of it. Townsend in his 'Flora of Hampshire' refers to it as naturalised in the I. of Wight, together with Hydrocharis Morsus-Ranæ and Villarsia by Dr. Salter in a small pool about 2 miles from Ryde on the Brading road. This locality is only a few miles from the one at Sandown, but the plant appeared to be quite wild in the pond where I saw it and was in full flower. The flowers are described in the books as being diœcious, but those I examined in the Sandown plants had anthers on the usually barren stamens of the female flowers, and that this character is not uncommon is borne out by the following note which I have extracted from the Journal of Botany for 1875 :—' (p. 239) Prof. Nolte in his classical paper on this plant and Prof. De Vriese, in his more recent observations on its geographical distribution state that only the female plant is known to occur in Great Britain and Ireland. Dr. Boswell (late Syme) also says in Eng. Bot. 3rd ed. that he has seen no male flowers; but he adds that anthers are occasionally produced on the usually barren stamens of the female flowers. Mr. Leighton in his 'Flora of Shropshire' (p. 254) indeed considers the plant hermaphrodite, and describes the pollen. It is usually considered diœcious, but on this subject attention may be drawn to a paper by Dr. Lindberg, read before the Botanical Society of Edinburgh, and reported in this Journal of 1872 (p. 317)* in which he shows that Hydrocharis, also generally deemed diœcious is in reality monœcious; the apparently separate plants being connected by branches under water. He says he has never seen a truly male plant.' "

Mr. Arthur Bennett had also drawn my attention to this extract and suggested that Stratiotes may resemble Hydrocharis in this subaquæous connection.

Mr. A. B. Jackson is the first of my correspondents to definitely assert that he has seen anthers in the female flower,

* Also in Trans. of Bot. Soc. of Edinburgh, vol. xi. p. 389.

though I think it still remains to be proved whether pollen from such anthers is capable of producing perfect fruit.*

The Curator of the Botanical Department of the British Museum reports that ripe seed of Stratiotes is unknown at the Museum, and that it probably does not occur in England.

N.B.—Ripe seed must not be looked for before the middle of October.

Mr. Nicholson and I have not yet detected an anther on Stratiotes at Sutton. I wished to postpone my paper, but Mr. Nicholson urged me to show Nolte's book and to give some account of it ; and we hope that this is only a preliminary to further study of the plant next season, in which we should like to enlist the help of other members. May I suggest as points for special observation :—

(1) The presence of anthers and pollen in the British Flower.

(2) The development of the pedicel and its join

(3) And especially of the fruit and seed.

(4) The age to which an individual plant lives, and its date of flowering. In Eng. Bot. ed. 1, Smith says, " A stoloniferous plant and truly perennial, though each root flowers but once, as in some species of Saxifraga, Sempervivum, etc."

(5) The degree of hibernation of Stratiotes in England. Do the plants lose all their leaves in a mild winter ? or merely rest at the bottom of the water and rise again the following year with the same leaves, young leaves developing in the centre ?

I wish to record my best thanks to Mr. Arthur Bennett and to Mr. Nicholson for much kind help ; to Mr. J. H. Gurney for the use of books from the Library of the Linnean Society ; to Mr. Clement Reid, Mr. G. C. Druce and other correspondents, and especially to Mr. Eustace Gurney for permission to use and examine specimens.

* Stamens and pistils are generally found in the same flower, but they have been sometimes observed to be on different plants ; and where they are found in the same flower, the anthers have been found to be barren. Linn. (Withering's Arr. Brit. Plts., vol. iii. p. 486, 4th ed.). Stamens numerous, some of them often fertile, so that the female plant alone frequently fruits. (E. B., 3rd ed. vol. ix. p. 80).

The following specimens from Sutton were exhibited when this Paper was read :—A plant with several young growing buds in various stages of development. Similar detached buds which had already started a separate existence ; one of them in section ; one with the membranous sheath still attached at base of stalklet. Fruit collected in September (see figs. 4 and 5). Specimen showing the joint of the pedicel (figs. 2 and 3).

DESCRIPTION OF PLATE.

Illustrations reproduced from my water-colour sketches of fruit heads collected at Sutton (E. Norfolk), by Mr. W. A. Nicholson on 24th September, 1905.

Fig. 1. Spathe with double keel on the smaller leaflet. Young fruit still erect and hidden by spathe. Larger leaflet hooded (pp. 189, 190).

Figs. 2 and 3. Pedicel and ovary, showing the joint or fold in the pedicel by which the fruit is enabled to bend (p. 192).

Fig. 4. A bending fruit (p. 192).

Fig. 5. Another fruit, showing torn spathe-leaves (p. 193).

LITERATURE RELATING TO STRATIOTES.

NOLTE, E. F. :—

Botanische Bemerkungen über Stratiotes und Sagittaria, Kopenhagen, 1825.

KLINSMANN, DR., in Danzig :—

Ein Beitrag zur Entwickelungs-geschichte von Stratiotes Aloides, in Botanische Zeitung, 1860, p. 81, 82, taf. 2, fig. A. a—c.

IRMISCH, THILO :—

Beitrag zur Naturgeschichte des Stratiotes Aloides ; in No. 6. of 'Flora,' (28th Feb. 1865,) Jahrgang 48, Regensburg, p. 81—91, t. ii, 1—20.

ASCHERSON, P. and GRAEBNER, P. :—

Synopsis der Mitteleurop. Flora, 1896—1904.

REID, CLEMENT :—

'The Origin of the British Flora,' 1899.

On Paradoxocarpus carinatus, in Trans. Norfolk and Norwich Nat. Soc. vol. v. p. 382 (with illustration), and vol. vi. p. 328.

SOWERBY, JAMES and SMITH, DR. J. E. :—

'English Botany,' ed. i. vol. xi. p. 379, and ed. iii. edited by J. T. Boswell Syme, vol. ix. p. 80, plate 1445.

III.

MERTENSIA MARITIMA, Gray, IN NORFOLK.

By Mr. W. H. Burrell.

Read 28th November, 1905.

In June, 1905, Robert Pinchen directed my attention to *Mertensia maritima*, Gray (*Pneumaria maritima*, Hill) growing on the shingle beach of the north Norfolk coast.

There were four plants grouped within a few feet of each other, one small, bearing no flowers, one slightly larger in bloom, and two still larger, having prostrate shoots nine inches long with flowers, and about twenty capsules in different stages of development. One of the plants had been nibbled by rabbits, and was looking sickly; the others were healthy and vigorous. I regret not being able to visit the locality in the autumn to see whether the seeds had ripened.

On the mainland of Europe, *Mertensia maritima* is a northern plant distributed from Lapland southwards to Denmark; it occurs also in Iceland, Faroes, Britain from Shetland southwards to Northumberland on the east coast, to Carnarvon on the west coast, and in Ireland, Wicklow Head. It is worthy of notice that the north Norfolk coast is approximately in the same parallel of latitude as the Irish station.

Whether the plant is a native of Norfolk will perhaps best be decided by time; if the latitude is south of the limit it will not maintain its existence here; but the conditions do not appear to be inconsistent with its being a native which has hitherto escaped observation.

Mr. Arthur Bennett has been good enough to examine a dried specimen and vouch for its identity.

IV.

NOTES ON THE ARCTIC WHALE-FISHERY FROM YARMOUTH AND LYNN.

By Thos. Southwell, F.Z.S., V.-P.

Read 30th January, 1906.

The importance of the Whale-fishery not only from a commercial point of view, but also as a training school for our naval seamen, was fully recognised of old and encouraged by successive governments, and there was scarcely a seaport on the East coast which did not more or less at some time participate in it. In our own county, Yarmouth and Lynn long took part in the venture, but the materials for a history of the parts they played, like the object of their pursuit, are rapidly vanishing, the log-books kept during the voyages are lost or destroyed, and even tradition has for the most part faded away; it therefore appears most desirable to put on record such scanty materials as remain, and this has induced me to collect the scattered facts which have come under my notice in many years' study of the group of animals to which they refer, with a view to preserving them ere it is too late, and in accordance with our tradition of giving precedence to local matters, I have in what follows confined myself to two Norfolk ports—Yarmouth and Lynn.

The Whale-fishery, as you are doubtless aware, is an exceedingly ancient industry; the Norwegian voyager, Ohthere, in his narration to King Alfred, spoke of the Whales captured in the 9th century in his own country, and the Basques were Whale-fishers in the Bay of Biscay certainly as early as the 13th century; they are even said to have frequented the Banks of Newfoundland and the Gulf of St. Lawrence in

search of Seals, Sea-horses and Whales a century before Columbus first landed on our oldest colony: certainly ships from Hull and Bristol were seaching for Whales in these waters in the year 1593, and one of them profited by the wrecked remains of other vessels which had been there before them.

Did Norfolk take part in this early fishery ?

The researches of Mr. Walter Rye in the early history of Cromer have established the fact that "Cromere" in the 15th century was a seaport of no small importance, and it is even said that Robert Brown, a mariner of Cromer, in the year 1405 re-opened commercial relations with Iceland whose waters formed the summer resort of the southern Right Whale, which was the prey of these ancient fishermen. Mr. Rye also states that in the will of John Sparks, A.D. 1483, mention is made of his cottage called "Bluberhouse." It is difficult to imagine the use of the word for any other purpose than that to which it has been applied in comparatively modern times, viz., a building for rendering out and refining the fat of Whales, and it seems to be strong presumptive evidence that Cromer added the pursuit of the Whale to her other marine industries; but I know of no other evidence in support of Mr. Rye's suggestion. However that may be, it is evident that 200 years later frequent communications took place between far-off Iceland and probably Yarmouth, for Sir Thomas Browne says that there was a native Iceland pony at that port which had a singular taste for barrel staves and hoops, and that sheep also had been brought over. The doctor had a correspondent in Iceland, one Theodore Jonas, a Lutheran minister, and says (1663) that a native who came yearly to England, constantly visited him before his return. This period of the fishery, however, does not immediately concern us, for the Whale pursued by these ancient mariners was an inhabitant of the temperate waters of the N. Atlantic, and quite distinct from the Polar Right Whale (*Balæna mysticetus*) which in the 16th century was an unknown species and only brought to light shortly after Hudson's visit to Spitzbergen, then thought to be a part of Greenland, when

in consequence of his report as to the abundance of these creatures in the newly discovered seas and the increasing scarceness of the Atlantic Whale, in 1611 vessels from London and Hull directed their attention to this much more valuable animal, and for the first time it came in contact with man, the destroyer.

I cannot find it recorded when the port of Yarmouth first sent out vessels to the Greenland Fishery, but that they were very early in the field is evident. Palmer, in his 'Perlustrations of Great Yarmouth,' states that in the year 1627, the "Fellowship of English Merchants" complained to the Privy Council that Nathaniel Wright, previously one of their directors, had joined Thomas Hoarth, and had drawn away one Sampson, their chief Harpooner, and were fitting out ships at Yarmouth for the Whale-fishery, and prayed that the ships might be stayed. According to Manship's 'History of Great Yarmouth,' a dispute arose as to two ships fitted out in that port, which I take to be those referred to above, and in the year 1631 the Bailiffs received a letter from the Lords of the Privy Council, which like other great bodies appears to have moved rather slowly, ordering them "Not to suffer two shipps to goe forth untill good security bee entered into, that they shall not bend their course into any parts within the privileges of the Greenland Companye." For the result we must again go to Palmer's 'Perlustrations.' and there we find that notwithstanding an appeal setting forth that a loss of £2000 was sustained by the delay, the privileges of the Company were maintained.

The above prohibition refers to a monopoly granted in 1613 to the Muscovy Company of London by James I., and renewed by Charles in 1636; this absurd assumption of jurisdiction over the high seas on the plea of pre-discovery led to no end of disputes and even bloodshed, chiefly with the Dutch, and was, as instanced above, mainly prejudicial to his own countrymen; although the restriction fell into abeyance it was not abolished till 1672.

In 1696 all restrictions were removed and a more enlightened policy introduced, but the industry still languished, and in

1733 a bounty of 20s. per ton on all whaling ships over 200 tons was granted. This seems to have created some revival from Yarmouth, for in 1746 the "Elizabeth and Mary" returned from Greenland with four Whales. Another vessel was fitted out in 1753 the return of which with one Whale is recorded in the 'Gentleman's Magazine' under date of 23 July of that year, and on 10 July, 1754, the same Magazine mentions the arrival in Yarmouth Roads of the "Alexander" with three, and the "Charming Polly" with five Whales. Palmer records that in 1758 the "Three Brothers" of Yarmouth, returning from Greenland with one Whale, was captured by the French, but the latter had not always their own way, for the same authority informs us that in the previous year a Yarmouth Greenlander, the "Prince William," assisted by the "Hope" of London, captured a French privateer with 47 men and "3 ransomers" on board, and carried her into Shields.

In 1764 seven Yarmouth ships were employed in the fishery, apparently with very little success, for they only brought home seven Whales. The English, notwithstanding the encouragement offered by the government, still seem to have displayed very little energy in the prosecution of the Whale-fishery, and were driven from the field by the superior foresight, energy, and economical methods of the Dutch, who between the years 1770 and 1778, both inclusive, made 1174 voyages against 603 by the English, but Anderson (Origin of Commerce) referring to the year 1762 and writing of the port of Yarmouth, says it had lately entered pretty much into the Greenland fishery and sent out several ships annually. Quoting from a diary kept by one of the Youell family under date of 23 July, 1780, Palmer gives the following extract: "Went on board the 'Yarmouth' and 'Norfolk' Greenland ships which have caught seven Whales each;" the early return of these, and other whaling vessels to be mentioned further on, seems remarkable. It is further stated in the 'Perlustrations of Great Yarmouth' that "in 1801 twenty ships were employed in this fishery, and returned from Greenland with rich cargoes, but heavy losses subsequently

occurred, and early in the present [nineteenth] century the Whale-fishery from Yarmouth was abandoned." I have no means either of confirming or confuting the above statement, but am inclined to think that it must be an over-estimate as to the number of vessels out from Yarmouth in 1801, more especially as only 64 ships are recorded as having been fitted out from British ports in that year; the decline of the fishery probably coincided with the decrease in the amount of the bounty which was at its maximum of 40s. per ton in 1781, and after a gradual reduction was finally abolished in 1820, this and the lessened consumption of Whale oil by the introduction of gas lighting about that time, probably brought about the decay and final virtual abandonment of the Whale fishery from the English ports.

The following are the names of the Yarmouth whaling vessels I have met with: Elizabeth and Mary, Three Brothers, Prince William, Trelawney, Hunter, Argus, Yarmouth, Norfolk, Alexander, and Charming Polly. With regard to the vessel named the "Yarmouth," more than once mentioned above, an interesting fact was communicated to Mr. Patterson by a gentleman named Mitchell, who stated that the old vessel was sent to Australia in 1853, and he distinctly remembered her being beached at St. Kilda, near Melbourne, and converted into a bathing hut, the area in front being fenced in to keep out the sharks, and that he had frequently used the hulk for that purpose.

The "oil houses" used for refining the blubber were situated at the south end of the town near the present Trinity Wharf, and I believe are still in existence, although used for other purposes.

The same absence of continuous and authentic records also unfortunately applies to the port of Lynn, which was probably engaged in the Whale-fishery quite as early as Yarmouth; but in answer to my enquiries I learn that the log-books of the vessels have been destroyed, and so far as is known no official records of the voyages exist. Sir Hamon le Strange, of Hunstanton, writing of a Sperm Whale cast ashore on his manor in 1626, says he was assisted in its cutting

up and disposal by "some that had bine in the Greenland fishing for Whales," doubtless men belonging to Lynn, from which it would appear that the Greenland fishery was even at that time no new industry from that port. In Richards' 'History of Lynn,' published in 1812 (vol. ii. p. 1163), the following passage occurs: "The trade to Greenland and Davis Strait, or what is called the Whale-fishery, is another branch in which Lynn has been concerned for many years: and as it is still persevered in, it may be presumed to have proved no ungainful concern. The ships fitted out for this trade generally sail in March and return about July. Three or four ships have been usually employed in this trade, and sometimes more, but we understand that there are only two fitted out this year" (1812 ?).

In Stacy's 'Norfolk Tour' (1829, vol. i. p. 443) the above is quoted with the following addition: "but the Greenland Trade has, within the last two or three years, been entirely discontinued in consequence of the great decrease in the demand for oil." There can be no doubt a brisk Whaling trade was carried on by the merchant aristocrats of Lynn, the Bagges, Hogges, Everards, and others throughout the 18th and early part of the 19th centuries. Lynn was then the port of entry for large quantities of coals, timber, wine and cork, and for the export of wheat and wool, which by a very extensive inland system of water communication were dispersed over, or collected from, several counties, but the trade was gradually diverted into other channels, and the inland water traffic superseded by railways; the great merchants whose stately houses still abound in the town, though degraded to baser purposes, gradually withdrew from vulgar competition.

In the 'New Annual Register' for 1788, p. 32 (as quoted in Richards' Lynn) is recorded an adventure which occurred to Capt. Cook, of the "Archangel," which arrived at Lynn from Greenland with two fish in August of that year—the captain was attacked by a bear and the surgeon, who was fifty yards away, by a lucky shot killed the bear instantly, thus saving the captain from an untimely death. The

whalers of the present day do not regard Bears as very formidable animals, no less than 200 having been killed by them in the past season of 1905, and four brought home alive.

I am indebted to Mr. H. J. Hilling of Lynn for the following extracts from a memorandum book formerly in the possession of the late Mr. Aldridge of Blackfriars Street, Lynn.

1795. July 21. Arrived [at Lynn] the *Balæna* from Greenland with six fish; the *Experiment*, seven, and the *Form* with three fish.

1796. July 9th. The *Experiment* from Greenland arrived with eight fish.

1797. July 28th. The *Fountain* from Greenland arrived at Lynn with eleven fish; and the *Experiment* also arrived with ten.

1798. Aug. 3rd. *Experiment* in the [Lynn] Roads with one fish.

1799. July 23rd. *Experiment* arrived with four fish.
July 26th. *Fountain* arrived with seven fish.

1800. July 21st. *Experiment* with six fish.
Aug. 2nd. *Fountaine* with five fish.

1801. July 19th. *Fountaine* arrived with eight fish; *Experiment*, two fish.

1802. July 15th. *Experiment*, nine fish.
July 18th. *Fountaine*, six fish.

Mr. Hilling was also kind enough to write me as follows: "Thomas Baines, the grandfather of Thomas Baines of Kings Lynn the artist and explorer, was captain of a small vessel engaged in the Whale-fishery from the port of Lynn. In looking through some more of Baines' papers I came across a page out of the log of the *Experiment*. It is headed 'in Greenland,' 1804, and gives two days' work, Monday and Tuesday, 23rd and 24th April. On the reverse is a rough drawing of the *Lady Andover*—a three-mast vessel, 'built in the year 1805, of Wells.'"

The 'Norfolk Chronicle,' under the date of August 15th, 1818, records the arrival at Lynn of the whaler *Enterprise*, Capt. Sanderson, with eleven fish, supposed to produce

LEEDS MUG.

In the collection of Mr. W. H. Booth. *See page 209.*

OLD BLUBBER HOUSE AT LYNN. *See page 209.*

NATURAL HISTORY

160 tons of oil and estimated to be worth £6000 exclusive of whalebone, the whalebone alone which should weigh eight tons at the present value (£2250 per ton), would be worth £18,000. Capt. Manby of Yarmouth, who went to Greenland in the ship *Baffin* of Liverpool, Capt. Scoresby in 1821 writes of Capt. Sanderson of the *Enterprise* as "a gentleman of great ability and possessed of twenty years' experience in whaling matters," the *Baffin* spoke the *Enterprise* on June 7th, in the Greenland sea.

The last date of a whaling voyage from Lynn given by Mc Cullock is the year 1821, but I am inclined to think that year was not quite the finish of the fishery from that port.

Amongst the privileges granted by the government in the year 1749 with a view to the encouragement of the Whale-fishery in addition to a bounty of 30s. per ton, the crews of the vessels were exempted from impressment, and Mr. W. O. Smith of Hunstanton, tells me that his father who was boat-steerer in a whaler from Lynn held such a certificate.

Mr. W. H. Booth, of Handford Lodge, Ipswich, was good enough to send me the photograph (see illustration facing p. 208) of a Leeds mug in his possession* on which is a picture of the whaler *Balæna* of Lynn with her boats out attacking a whale and bearing the following inscription:—

"A Ship from Lynn did Sail
And a Ship of noble fame
Captain Baxter is Commander
The Beleana is her name."

I have a distinct recollection of seeing, when a boy, at Lynn, an old vessel lying at the Whaling wharf in the Friar's fleet, the entrance to the river Nar; there were two erections, one on each side of the river for the purpose of boiling down the whale blubber, know as "Blubber Houses." That on the west side of the river, on Pindar's bank, for a photograph of which forming the illustration facing p. 208 I am indebted to Mr. Alfred Smith of Lynn, is still standing, and there are dilapidated remains of the wharf at which the vessels discharged their cargoes, but the building on the Town side of

* Now in the Norwich Castle Museum.

the river, near the Friar's Gateway, the uprights supporting part of which were formed of Whales' bones, has long been removed. There is also a fine old timbered house situated in Bridge Street, South Lynn, now used as a public-house with the sign of the "Greenland Fishery," and bearing the date 1605; a house bearing the same sign is in Oak Street, Norwich. The following are the only names of Lynn whalers with which I have met: Archangel, Balæna, Enterprise, Experiment, Form, Fountain, and Jago.

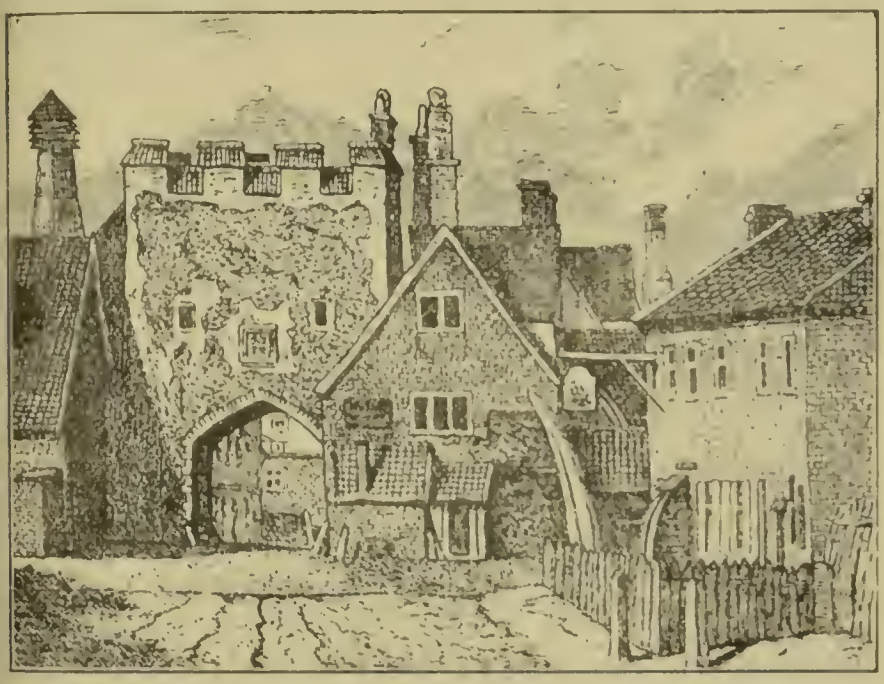
I doubt not most of those present have from time to time been surprised at coming upon cetacean remains in the form of the lower jaw-bone of the Greenland Whale erected as an ornamental arch or used for gate posts or fencing, that too in the most unlooked-for places often far from the sea, and have wondered "how they came there!" It was the practice of the whalers to bring these bones home lashed to the rigging and to dispose of them as trophies or for the purposes to which we see them even now applied; the number still remaining witnesses to the success of those ancient fishermen. They are rapidly disappearing from decay and other causes, and it may be well to give a list of such as I have seen or as have come to my knowledge. As they doubtless all emanated from Yarmouth and Lynn, I will commence with such as most likely were derived from the former port and work round the coast to Lynn and its neighbourhood.

First those in or near *Norwich*, all of which were probably derived from Yarmouth.

A jaw-bone which formerly stood in the late Mr. Noverre's garden in Theatre Plain is now in the garden of 5 *Ipswich Road.*

In a garden at the back of the old Cotton factory in *St. Martins*, the rami of the lower mandible of a Whale cut into pieces and forming part of a fence about four feet in height, are still to be seen although very much decayed. They were found by the then occupier of the garden buried in the ground, and he told me that at the time he found the bones an old gentleman stated that he remembered a jaw-bone which was set up near St. Augustine's gates, and he was inclined to believe was the same as that then discovered.

There formerly stood just outside the Conisford Gate, at the southern entrance to the city by King Street, an old Inn called the "Ship," in front of which was a Whale's jaw-bone with other portions on each side the entrance door as shown in the accompanying illustration, reduced from a sketch by John Ninham (dated 1793) in Fitchie's 'Gates of Norwich.'



THE "SHIP" INN, FORMERLY STANDING NEAR THE CONISFORD GATE, NORWICH

From Fitchie's 'Gates of Norwich.'

I have not been able to discover precisely when this house was demolished, but Messrs. J. & J. Colman kindly inform me that their paper mill which now occupies its site was completed in 1883, and that probably it was cleared away in 1881.

An Inn called the "Whalebone" existed in King Street on the spot now occupied by a building used by Messrs. J. & J. Colman as a Seed Warehouse next, on the city side, to Cooper's Biscuit Factory: the premises occupying the site are described in a deed of conveyance dated 1852, as "all that messuage or tenement formerly used as a public-house

and called the 'Whalebone,' with tenement or dwelling-house adjoining the north side thereof," and an old inhabitant assures me that it was ornamented by cetacean remains similarly to the "Ship." Another Inn bearing the same strange device is still standing in New Catton, and the jaw-bone to which doubtless it owes its name is now in the garden of Clare House near by. A similar relic is to be found in the garden of the Grange, Old Catton, lately in the occupation of Mr. Arthur Bunting. I am informed that a public-house called the "Half Moon," on the Dereham Road, had the scapula of a Whale for a sign.

Yet another such arch is in the garden of the Mill House at *Cringleford*, which Mr. Candler believes was placed there about the time the mill was rebuilt in 1795.

Aylsham. A jaw-bone forms an arch at the foot of a bridge over the back-water at Messrs. Bullock's water-mill, it has been there many years and nothing is known as to its history.

At *Slaughden*, near Aldeburgh (Suffolk), Mr. James Hooper informs me that the sign of the Ferry House, the "Three Mariners," is inscribed on a whalebone, he supposes a jaw-bone; to make sure he entered the house and inquired.

Yarmouth. The poet Southey, writing to his wife from Ormesby on 29th May, 1798, says, "Another peculiarity about Yarmouth is the number of arches formed by the jaw-bones of a Whale; they trade much with Greenland there" (Life and correspondence of Southey, by his son (1849), vol. i. p. 335). Several of these trophies are still in existence; one at the back of the *Bank House*, formerly occupied by the late Mr. Brightwen, now Barclay & Co., Limited. A similar arch formerly stood on the *South Denes*, but it is now in the premises of the Yarmouth *Gas Works*. Mr. A. Lark in a letter to the Yarmouth 'Independent,' dated 6 July, 1901, says he well remembers about 45 years before that date (1856 ?) being told by a very genial old gentleman that "he had been captain of a whaler which belonged to and sailed from Yarmouth, which vessel was named the 'Yarmouth,' and he was the captor of a Whale the jaw-bone of which he brought home to Yarmouth and which afterwards stood on the South Denes. From this

Whale, he told me, he secured 30 tons of oil;" a very fine Whale, and likely to be impressed on his memory; but I think the particular bone in question, of which the accompanying illustration is from Palmer's 'Perlustrations,' had been in its place on the Denes surrounded by the "lovers' seat," at an earlier date than could be assigned to it from the above statement. It will be seen above, that the "Yarmouth" went to Australia in 1853. Mr. Lark mentions a jaw-bone in *Southtown* "covered with ivy in a garden on Gordon Road, late in the occupation of Mr. Sacret." Mrs. R. P. Chamberlin informs me that a jaw-bone in the form of an arch covered with ivy is in the garden of *Westbourne Lodge*, Beccles Road, Yarmouth, and that other portions have been used for railings to some cottages near by.

Caister Castle. I have seen in the garden of Caister Castle a fine jaw-bone partially covered with ivy.

We now pass into the Lynn district.

Wells. Mr. Alexander Napier tells me that there is, or was, a jawbone arch in the town of Wells.

Wighton. The same gentleman tells me that there is a very large arch at the entrance to Mr. Powell's drive at Wighton.

Thornham. Mr. Hy. Mayes of Lynn, in a letter to the 'Lynn Advertiser,' states that during a stay at Thornham he "came across eight whalebones in that village. One stands at the old school-house corner, one is a gate-post in the lane near the Life-boat Inn; there are two in Mr. Fred Lane's yard; two in Mr. Tom Jones' field near his farm-house, and two pieces, apparently having been one gate-post, lying in a dry ditch in the Titchwell road, near the Thornham allotments. I am informed there are several others on Mrs. Ames Lyde's estate at Thornham. I also remember 50 years ago there was a fine specimen upon the sand-hills as a boundary between Thornham and Titchwell. . . In my opinion [he says] these whalebones at Thornham were taken there from Kings Lynn by the late William Hogge, Esq. [grandfather

to Mrs. Ames Lyde] who I believe employed vessels in the Greenland fishery."

Congham. Mr. G. S. Buxton tells me that there are several lengths of Whales' bones in the form of posts about 2 feet 6 in. above the ground, against the corners of walls in the garden at Congham Lodge.

Snettisham. Arch on the Knoll, Ken Hill, by the foot-path on the property of Sir Edwd. Green, Bart.

East Dereham. A Whale's jaw-bone formerly stood at the entrance of a yard in High Street, East Dereham, occupied by a grocer, named Barkham.

Necton, near Swaffham. Another has been for many years at the garden entrance to a small farm-house in Chantery Lane, Necton.

Lynn. There are three sets of jaw-bones in the garden of a house in Stonegate Street, Lynn, formerly occupied by Mr. Joseph Wales, owner of the "Jago," Capt. Curtis; the house was built and the garden laid out in 1811, and it is believed that the bones were placed there about that time. They are in bad condition.

A fine jaw-bone formerly in the garden of the London and Provincial Bank (late Jarvis and Jarvis) on the Tuesday Market Place, is now erected at the Lynn Museum.

A similar trophy was formerly standing at the back entrance to a house in Bird-cage Walk, Lynn. I could not find any trace of it and presume it has been removed.

The roof of the shed adjoining the old Blubber House at Lynn as mentioned above, was supported by Whales' bones, but the building has been removed.

Wiggenhall St. German's. An old building used as a smithy has built into its brick walls 15 or 16 Whales' bones, they stand at the corners and at intervals all round the building, the wall plates at the eaves resting upon them, seven or eight feet from the ground.

Downham. The sign-board of the "White Hart" public-house in Bridge Street, Downham, is supported by a Whale's jaw-bone, which I have not seen.

Mr. Wm. Easter of St. Germain's, to whom I am indebted

for the above information, also informs me that at Magdalen, 8 miles up the river Ouse from Lynn, is a sharp bend in the river known as "Blubberhouse Point," but as to the origin of the appellation nothing now is known.

I doubt not there are many other such interesting relics which I have not seen but of which I should be glad to be informed.

V.

THE CLASSIFICATION OF NORFOLK FLINT IMPLEMENTS.

By W. G. Clarke.

Read 30th January, 1906.

When examining a large collection of the flint implements and weapons of prehistoric man, it is obvious that they represent, from the roughest to the most highly finished, successive stages in the development of mankind. Differences of design, chipping, and patination, denote varying degrees of antiquity, for perfection in the art of chipping flint was only attained by the labours of an extremely lengthy period. From the commencement of the study of prehistoric archæology until a few years ago, the division into Paleolithic and Neolithic stages of culture sufficed for all purposes. In Belgium, France, and the Thames Valley, the gravels yielding Paleolithic implements have been elaborately classified, and efforts are now being made similarly to divide the implements of the Neolithic age, though as they are all found on the surface, the difficulties are greater, for no assistance in determining

relative antiquity can be rendered by the geologist. But in addition to these two long periods, with their comparatively well-marked line of demarcation, a third, the Eolithic, has been added since 1892.

I. EOLITHIC.

As Professor A. C. Haddon, Sc.D., F.R.S., said in his presidential address to the Anthropological Section of the British Association in 1905:—"It is obvious that the shapely Paleoliths of the older gravels could not have been the first attempts at implement-making by our forefathers." Their ruder prototypes are called Eoliths, and M. A. Rutot, Conservateur au Musée Royal d'Histoire Naturelle de Bruxelles, considers* that the period during which they were used was more important and probably longer than the combined Paleolithic and Neolithic periods. Admitting the extremely gradual growth of all human culture and skill in handicrafts, the earliest stone implements chipped by man must have been very rough, and this renders the artificial nature of the chipping on Eoliths liable to dispute. Among the arguments in support of their purposeful adaptation by human agency, are the facts that archæologically the chipping has the characteristic appearance of that of man in later times, and the implements are of such forms as would be most easily made; and that geologically they usually occur where one would expect to find any traces of man's handiwork older than the Paleolithic age. The recurrence of certain particular forms; the fact that in most instances the edges are quite sharp, and that some of the best chipping is in hollows between points that are unchipped, seems strong evidence in favour of their acceptance as the earliest existing products of man's industry.

Eolithic implements have been found in large numbers in the plateau gravels of Kent, Surrey, Sussex, Essex, Hampshire, and Wiltshire, the north of France, Belgium, Germany, in

* 'L'état actuel de la question de l'antiquité de l'homme.' Bulletin de la Société Belge de Géologie de Paléontologie et d'Hydrologie, vol. xvii. p. 427.

Egypt, near Johannesburg, and in Queensland. In Kent the implements occur in plateau gravels, which appear to have been deposited when the present Wealden plain was occupied by a range of hills elevated about 2500 feet above the present surface, and when the rivers flowed north and south from the watershed at least 400 feet above their present level.*

To the English localities already recorded I have now to add Eaton, near Norwich, which (with the exception of the somewhat doubtfully worked flints found in the Cromer Forest-Bed at Runton by Mr. Lewis Abbott) is the first record for Norfolk, and with the exception just named the most northerly spot in Europe at which Eoliths have yet been discovered. The first implement was found on the surface last year by Mr. G. Rye, of Norwich, and my identification of it as an Eolith was confirmed by Mr. Benjamin Harrison, of Ightham, and Professor T. Rupert Jones, F.R.S., F.G.S. The former described it as a superior kind of Eolith representing the transitional period when the early workers began to flake in a better style, in addition to the characteristic hacking. Professor T. R. Jones says:—"The hollow on the concave edge shows by its large and small chippings that it was produced intentionally by human agency." This implement has a bulky butt, some of the more obtrusive angles of which have been removed by narrow chippings. Beneath, it is flat, and on one side is a big hollow in which there has been plenty of typical hacking. As a result of this concavity there is a comparatively narrow point from which various tiny flakes have been removed. Its colour is a peculiar bronze-brown with a mottled appearance in places; its greatest length is just under, and greatest width just over, three inches. After confirmation of the Eolithic character of this implement, Mr. G. Rye and I sought for the bed from which it came, and in the stones excavated from Eaton lime-kiln have found over 100 Eoliths, taken from beds varying in thickness from a few inches to several feet, and in depth from the surface from about 16 to 30 feet, the surface here being just below the 100-foot-level.

* British Museum 'Guide to the Antiquities of the Stone Age,' p. 25.

Four specimens were submitted to Professor T. R. Jones, F.R.S., who states that there is uncertainty with regard to one, but the others definitely show their human origin. Of one specimen he says :—" It seems to be definitely chipped with a nearly circular blunt edge, some chief chippings of large, vertical, parallel flakes on the thickest part, making it a blunt chisel. The stone has been flaked off some former block as the smooth side shows ; the other side retaining some of the original rough surface." Another implement he describes as a " fragment of a coarse flake, struck off a block, of which a part of the original surface remains on the converse side of the specimen. Some bold vertical parallel chippings have given it an irregular rhomboidal shape with a sharp projection between two hollow shoulders on one edge. The formal chipping being intentional shows its human origin." Four other specimens were carefully examined by M. Rutot, of Brussels. All he considers undoubted Eoliths. The best specimen, he says, is derived from a flint intentionally fractured, with bulb of percussion, and appears to be a scraper, utilised at one end, and bearing " la retouche d'accommodation " on the two sides. The next best implement also appears to be a scraper, and is certainly made from a flint fractured intentionally with bulb of percussion. A third example he described as a core, afterwards used as a hammer, and a fourth resembles a " retouchoir." M. Rutot considers that these implements are most nearly allied with those of the Mesvinien type, the later of the two Eolithic periods, the earlier being the Reutelien. Of the Mesvinien period he says* the characteristic is the very great variety of implements, and the absence of typical forms, uniformly produced. Mesvinien man never having mined flint, but being always restricted to gathering the blocks from the flint-beds which then covered immense areas, it is easy to conceive, says M. Rutot, that as the nature and form of the flints varied considerably, equally would the forms of the chipped implements.

* " Sur l'age des gisements de silex taillés découverts sur le territoire des communes de Haine-Saint-Pierre, Ressaix, Epinois, etc." By A. Rutot, 1899, p. 27.

All the Belgian implements of this type appear to come within three different classes, answering generally to the three uses of striking, scraping, and boring.

Most of the Eaton Eoliths are formed of a half or smaller portion of a flint pebble which has been broken in two or more pieces. Only in a few instances has the flat under portion been chipped. As a general rule most of the crust is left on the top and the chipping has been done round the edges of the flint. In many respects it differs from the hacking of the Kentish Eoliths and is undoubtedly a decided stage in advance, for there are, on practically every implement, signs of genuine flaking, some of the narrow strips of flint thus removed being nearly three inches in length. With a somewhat limited number of specimens it is impossible to generalise accurately, but certain types seem to recur. There are scrapers of irregular form, but with one end abraded, apparently by use, as the other edges are sharp; big borers, the points being made by chipping a hollow on each side; massive square-ended implements; and others, bearing a family likeness to the axes of the Paleolithic period, though lacking their finish. Similar implements, "between the typical Eoliths and the earlier Paleoliths,"* appear to have been found in the valley of the Darent, West Kent, where the chipping is finer and types more numerous than in the earlier examples from the true plateau gravels. One implement "shows work on all edges, with slight attempts at flaking, and at one extremity there is a curved portion resembling the concave scrapers of Eolithic gravels." This describes, fairly accurately, the first implement found at Eaton.

According to a table given by M. Rutot† the Kentish plateau Eoliths belong to the Middle Pliocene, and those of the Cromer Forest-Bed to the Upper Pliocene, both, of course, in the Tertiary period. In the Quaternary period come the Reutelien and Mesvenien industries, both, in Belgium, characteristic of the first ice-period, the former marking its waxing and the

* "Notes on Prehistoric Man in West Kent," 'Antiquary,' March and April, 1905.

† "L'etat actuel de la question de l'antiquité de l'homme," p. 437.

latter its waning. In that part of the Eaton pit from which the Eoliths come the chalk is overlaid by about 30 feet of sands and pebbly gravels. Eoliths occur in the latter chiefly in two small beds, one about 16 feet from the surface and the other resting on the chalk, a foot above which implements have been found *in situ*. Mr. F. W. Harmer, F.G.S., kindly examined the strata and believes that the sands and gravels are early glacial, and older than the brick-earth which occurs immediately north of Norwich. The comparative regularity of the stratification of the gravel and the big beds of sand seem, in my opinion, to indicate that the conditions under which they originated were not those of torrential streams, thus rendering more difficult any explanation of the chipping on these flints as the result of natural forces. Supposing that man were pre-glacial, the floods that marked the southward extension of the first great glaciers would naturally sweep his flint tools and weapons from the land-surface and deposit them among other flints in beds of gravel. Or, similarly, if man dwelt in the district during an inter-glacial period. But on this question we can, in Norfolk, speak with little confidence, and much more investigation is needed before a satisfactory decision can be arrived at.

II. PALEOLITHIC.

Owing to the sparsity of Norfolk localities in which Paleolithic flint implements have been found, and the absence of reliable data as to the various horizons, it is improbable that until further excavations are made and scientifically described, anything will be added to the East Anglian classification mentioned by Mr. C. H. Read in the 'Guide to the Antiquities of the Stone Age in the British Museum.' (p. 8.) He there differentiates three horizons of beds yielding Paleolithic implements, all inter-glacial, and one older than the chalky boulder clay, the succession of beds in descending order being (1) Hessle boulder clay, (2) late paleolithic implements, (3) purple boulder clay, (4) intermediate paleolithic, (5) chalky

boulder clay and, (6) early paleolithic. Though early, intermediate and late Paleolithic implements all occur in the watershed of the Little Ouse, none of the early or intermediate appears to have been recorded from the Norfolk side of the stream, and in the absence of detail it seems impossible to classify the twenty Norfolk localities with which we are acquainted, although those in the Little Ouse and Thet valleys undoubtedly belong to the late Paleolithic period. All the pits below Thetford have been closed for some 25 years past, and are now quite overgrown. But in the river-drift at Snarehill, about a mile above Thetford, on low ground some 200 yards from the left bank of the river Thet, well-worked Paleolithic implements have been found at odd times during the past 15 years, while raising stone with which to mend the roads. Mr. A. G. Cronshey, of Thetford, who secured those found about 1890, has a pick 8 in. long and 4 in. wide at the butt, which has the original crust; a hatchet, almost rectangular, 7 in. by $3\frac{1}{2}$ in.; three small axes, and an oval implement. About 1900 a fine axe 10 in. long, 9 in. in girth and weighing 2 lb. 10 oz., was found here and is now in my collection. Stone for roads on the Shadwell estate was again raised from this pit in the winter of 1904–5, and some excellent implements were discovered. The score or so of implements then found are of varying types, as a rule splendidly chipped, and very symmetrical. In some cases they have the ochreous patina on one face only, while in others the gravelly stain covers the whole surface. Mr. F. Russell, of Thetford, has eleven good examples, perfect in every respect, and several others not quite so good. The main types are four, (1) the ordinary axe, (2) the pick, (3) narrow oval implement, (4) broad oval or discoidal implement. The biggest specimen of each type measures respectively $5\frac{1}{4}$ by $2\frac{3}{4}$ by $1\frac{1}{4}$ in. thick; 8 by $3\frac{1}{2}$ by 2 in. thick; 5 by 3 by $1\frac{1}{4}$ and 3 by $2\frac{1}{2}$ by 1. The picks especially are very fine, having big butts and long tapering points. An axe belonging to Mr. W. A. Dutt, of Lowestoft, is $7\frac{1}{2}$ by 3 in. with a girth of 9 inches at the butt and $7\frac{1}{2}$ in. in the middle. My own specimens are an axe $5\frac{3}{4}$ by $2\frac{1}{2}$ in. at the widest part, and $1\frac{1}{2}$ in. thick, one side ochreous, the other a lustrous black; and

a hatchet 7 in. long by $3\frac{1}{4}$ at the widest part, the original crust forming a handle. It is worked at the end, and to a length of 5 in. on one side, while on the other there is hardly any chipping.

III. NEOLITHIC.

There has been a good deal of discussion as to the relationship of Paleolithic and Neolithic man, as to whether the one was a direct descendant of the other, or whether Neolithic man was an invader who came some time after his prototype had disappeared. In England there appears to be a gap between the two periods, but on the Continent the presumed hiatus has been bridged over. If we accept the longer estimate of the duration of the Neolithic Age, which is now becoming more generally adopted by archæologists, in the period from 22,000 to 2,000 B.C. it is most probable that there would be considerable differences in the skill of the flint-workers. But while excellent classifications of the implements of the Paleolithic period have been attempted, little has at present been done with those of the Neolithic Age. Professor Doigneau has* divided it into two periods, the Campignien and Robenhausien; the implements of the former characterised by a resemblance to Paleolithic forms, by the "tranchet" and the double-ended axe; the latter by the polishing and perfecting of the implements, and a great increase in the number of types. In England we seem to have got little further than the suggestion of Messrs. M. A. C. Hinton and A. S. Kennard,† who place implements of the Cissbury type as next to the most recent Paleoliths in the Lower Thames Valley. In Norfolk it is, I think, possible to distinguish four classes of Neolithic flint implements, although supposing that they represent successive stages in the evolution of Iberian culture, it is extremely probable that they overlap, and accurate classification is thus rendered additionally difficult. As a preliminary classification I should suggest a division of

* 'Nos Ancêtres Primitifs,' Paris. 1905, p. 37.

† 'Proceedings of the Geologists' Association,' vol. xix. part ii.

Norfolk Neolithic implements into (1) early Neolithic, or Cissbury type; (2) intermediate Neolithic, or those typical of the heavier lands of the county, where boulder clay is the subsoil; (3) late Neolithic, or those from the lighter lands, or sandy sites, and (4) those of flint or other stone which has been polished, or of igneous rocks.

(1) Early Neolithic, or Cissbury type. Implements of this type are only found in a few localities, and probably only where ancient flint-quarries are situated, such as Cissbury Camp, Sussex, and other isolated hills in the North and South Downs; Spiennes, in Belgium; Larne, near Belfast: Grimes Graves Weeting, Massingham Heath, and Ringland, in Norfolk. The colour of these implements is perhaps their most characteristic feature. At Cissbury, Lieut.-Col. Lane-Fox (afterwards General Pitt-Rivers) says* in describing his finds, that the implements "at the time of their fabrication were of course of the natural dark colour of the interior of a block of flint. But in the course of ages, their surface has become whitened by decomposition, so as to resemble to the unpractised eye the outer coating of a flint nodule." He adds that some flakes dug out of a bed of clay "retain to a greater extent their original dark blue colour." At Grimes Graves, the implements are all grey or white, but more polished than those of Massingham and Ringland, probably due to the more exposed situation on the border of the fenland and the greater quantity of moving sand. Dr. C. B. Plowright says† that many of the Massingham implements were almost porous, resembling unglazed porcelain, but those found on the surface were as highly polished as ordinary Neoliths. Their colour varied from "creamy white to pale blue, often mottled with yellowish or brownish patches, and frequently covered by minute black or dark brown specks." These are also very frequent on the Ringland implements. I broke nine Ringland implements of the Cissbury type and found the white coating on all was extremely thin, not exceeding $\frac{1}{10}$ in. in thickness. The interior of three may be described as black, of four as

* 'Archæologia,' vol. xlii. p. 53 *et seq.*

† Trans. Norfolk and Norwich Nat. Soc. vol. v. p. 250.

dark grey and of two as light grey, one of the latter being the only piece of flint which had lost its crystalline appearance. In a few cases the surface was partly decomposed. The interior of these implements varies from black to blue and grey, and it may possibly be that the two latter are changes in the process from black to white, with a concurrent change in the texture of the flint from crystalline to opaque. It is certain that the first external weathering on the sandy site Neoliths is a bluish colouration, all shades and stages of which occur. In some the colouring is as delicate as the bloom of a peach; in others it is a decided patina of measurable thickness. On a small pointed scraper, a sandy site type, I found on Rushford Heath, the base of the implement appears to have been protected in some way, and has retained its original colour, but the pointed end shows various stages of weathering from blue to white. The investigations of Mr. B. C. Polkinghorne,* seem to prove that the alteration of colour in Cissbury type implements is due to the "dissolving out of the more soluble colloidal silica by rain-water charged with carbonic acid."

This white weathering seems to be one proof of the antiquity of these implements compared with others of the Neolithic age. Another is furnished by the absence of rubbed implements at the flint-workings. At Cissbury a single fragment of a polished axe was found one foot from the surface in a pit; they are equally rare at Spiennes, where the flint pits are on a larger scale than either at Grimes Graves or Cissbury. In Grimes Graves a polished basalt axe was found, but neither at Massingham nor Ringland have rubbed implements been known to occur. Further proof of the antiquity of these implements is provided by their partial rechipping in later Neolithic times, for the exposed dark inner flint is unaffected by the changes of several thousand years. Forty per cent. of the Ringland implements appear to have been rechipped, generally for use as knives or hollow scrapers.

The varieties of implements of the Cissbury type are few; most have but little secondary chipping and that chiefly on the edges; the flaking is bold and the implements bulky. This

* 'Neolithic Man in North-east Surrey,' p. 182.

is as we should expect in the evolution of culture and craftsmanship. Colonel Lane-Fox said that the implements found at Cissbury were almost all rough axes, and Sir John Evans adds that some of them were long and narrow, and some rough-hewn with the two ends almost of the same form. He also mentions flakes, boring tools, scrapers, and a kind of chopper or wedge for splitting the chalk. At Massingham, Dr. Plowright distinguished in addition to flakes and axes, picks, hammer-picks, borers, diggers, and hand-choppers, and a few scrapers. Some of the implements weighed as much as 5 pounds. Flakes were in some cases chips as thin as cardboard; others 6 or 8 inches long and proportionately thick. The Ringland implements of the Cissbury type were first found by myself on stone heaps, and on exploring the neighbourhood, Mr. G. Rye and I found that they had been gathered from the surface of two fields sloping upwards from the alluvium bordering the Wensum, and only from 30 to 40 feet above sea-level. The fields adjoin the highway between the Ringland Hills and the Beehive Lodge, Costessey, and rise gently to the base of a tree-covered ridge known as Cobbs Hills. I have no doubt that the flint from which the implements were made was excavated in the vicinity, but have not yet been able to find traces of the flint-pits, which may have been in the sides of the hills. The implements are easily distinguishable, as on a space of about 440 yards by 90 yards, every white or grey stone is chipped, and they are usually of large size. About 300 implements have been found at present. My own specimens—228 in number—appear roughly to fall into eight varieties, the proportion of each being as follows :—cores, 2 per cent. ; implements sloping from one side to the other, the thinner side worked to a cutting edge, 3 per cent. ; long, pointed implements, 6 per cent. ; axes, 7 per cent. ; oval or discoidal implements, 9 per cent. ; triangular implements, shaped somewhat like a French "tranchet," 10 per cent. ; square-ended implements, 27 per cent., and flakes, 30 per cent. Though individual flakes may be much smaller than individual flakes of the later Neolithic age, yet in a series the superior size of the Cissbury type is evident, and the same

applies to the implements. In Norwich Castle-Museum there is a Grimes Graves flake 5 inches long and 4 inches wide; Mr. G. Rye has one from Ringland $4\frac{1}{4}$ inches wide and 4 inches long; I have two, from Ringland, one $4\frac{1}{2}$ inches wide, and the other 4 inches wide, and 6 inches in length. Many of the implements are from $1\frac{1}{2}$ to 3 inches between the flaking ridges, and one core bears evidence of having had 10 flakes struck from it. Mr. G. Rye has two hand-picks, one $6\frac{1}{2}$ inches long, the other 6 inches, and a symmetrical axe just over 5 inches long, $2\frac{1}{4}$ inches at the widest part, and $1\frac{3}{4}$ inches at the cutting edge, tapering slightly to the other end. I have a symmetrical axe $4\frac{3}{4}$ inches long; another $4\frac{1}{4}$ long, and $\frac{1}{2}$ inch wide at each end; but the best is flat-backed, 5 by $2\frac{1}{2}$ inches at the widest part, extremely well shaped, and boldly chipped round the edges.

So far as the known evidence goes it seems probable that the communities at Grimes Graves, Massingham, and Ringland were the only contemporary ones in the county of Norfolk, and the conclusions to be drawn from the chipping of the Cissbury type implements apparently indicate a new race rather than fusion with the old, for the chipping is far below that of the later periods of the Paleolithic age.

(2) Intermediate Neolithic, or Boulder Clay type. While there is no difficulty in distinguishing Neolithic implements of the first and fourth groups, the dividing line between the second and third is by no means clearly marked, the one in some localities appearing to merge into the other. The implements of this group are, as a rule, found chiefly on the surface of cultivated fields on the heavier land of the county, although sometimes occurring on sandy patches with implements of more recent date. In contradistinction to the bulk of the implements in the next group, these are made from surface flints derived directly or indirectly from the boulder clay, and as a consequence of the material fracturing more easily owing to long exposure to the weather, the chipping, except in rare instances, will not bear comparison with that on the excavated flint of a later period, though certainly an advance on that of the Cissbury type. It is

possible, though I do not think it probable, that implements of this type might be contemporary with those of the Cissbury type, for while the excavated flint would weather in the course of ages, that which had been long exposed to atmospheric changes and had lost almost all its moisture before being chipped, would not be so affected. In most cases the flint is opaque, and in many instances the chipping is somewhat dull, possibly because of the absence of attrition, and the resultant polish, from particles of sand. As might be expected, the implements are, as a rule, poor in design, and their variety is limited. From Norfolk specimens in various collections the chief varieties appear to be axes of the rudest type, but with a well-worked cutting edge: hollow scrapers, somewhat irregularly worked, and occasionally right-angled instead of concave; pointed implements, probably used as borers, awls, or drills; rough fabricators; single-edged flake-knives; square-ended, oval, and thumb-nail scrapers; discoidal implements; implements of irregular shape with one end chipped to a working edge; and a number of nondescript implements worked all round, for which no definite use can be assigned. A typical form of implement is a nodule broken in halves, with the crust left on except at one end, where the chipping though covering only a small portion of the implement is often very delicate. As the majority of the implements are formed of portions of flint nodules, instead of flakes, they are much thicker than those in the next group. It is very probable that these are by far the most abundant implements in the county—in four hours' search at Ringland one day, Mr. G. Rye and I found 294 in addition to 42 of the Cissbury type—but they are overlooked except by those with some amount of special knowledge, as there is little in their outline to indicate that they are artifacts: it can only be determined by the chipping. While in the majority of cases it is quite easy to distinguish the intermediate Neolithic implements, in others there appears to have been a decided development and ultimately an approximation to the implements of the late Neolithic type. This is the case at Ringland where the chipping of some of the boulder clay implements

is so fine as to be indistinguishable from that by the sandy site people, and it is not improbable that these implements were made later in the Neolithic period than those of other boulder clay sites.

Thinking that in the different groups there would probably be varying proportions of implements with portions of the original crust remaining, and also with the top of the bulb of percussion removed by a single chip, I examined 316 of the Cissbury type, 1355 of the boulder clay type, and adopted the figures given in last year's 'Transactions' with regard to 593 implements from Thetford district, chiefly from sandy sites, with a few boulder clay and polished. In the first and third groups the majority of the implements are probably made of flint excavated from the chalk and the proportions with chipped bulbs of percussion are 38.9 and 47 per cent. respectively; in the second group where the implements are chiefly made from nodules, not flakes, the proportion is 20.5 per cent. As might be expected, the proportion of implements with pieces of the outer crust still remaining on them, is much greater in the boulder clay than in the other groups, being 46.8 per cent. in the Cissbury type, 47 per cent. in the sandy site type, and 71 in the boulder clay type. That the percentage of crust in implements of the boulder clay type is fairly constant is proved by three instances. On a typical boulder clay area, that on the table-land west of Norwich and between the rivers Yare and Wensum, the proportion of implements (581 in number) with chipped bulbs is 18.9 per cent. and those with crust 73.1 per cent.; in 333 implements from Ringland, the proportions are 26.7 and 70.2; and in 150 implements collected by Mr. W. A. Dutt in north-east Suffolk and along the banks of the Waveney, the proportions are 9.3 and 69.3.

(3) Late Neolithic, or Sandy Site type. The implements found on typical sandy sites, chiefly in the south-west of the county, are as a rule chipped, occasionally chipped and rubbed, and splendidly finished. They mark the height of perfection which the art of flint-working attained in Neolithic times. Not only is the workmanship of the implements from

arenaceous areas much more delicate, but they are of better design than those from the heavy lands. Many well-known forms, such as arrow-heads, spear-heads, lance-heads, needle-scrapers, and saws first appear, and the more delicately chipped triangular knives, awls, borers, hollow scrapers, fabricators, axes, and scrapers are only found among the sandy site Neoliths. Numerous implements are of semi-transparent flint, the flakes being very thin, and they generally occur in large quantities. Some are weathered a bluish colour, and many of these have been rechipped. As the rechipped portions have not weathered at all it is obvious that even this section of the Neolithic period must have been of long duration. Isolated specimens of the sandy site Neoliths are found in boulder clay areas, and boulder clay implements not infrequently occur in localities where the sandy site implements are extremely abundant. With regard to the number of sandy site implements, on August 31st, 1905, Mr. W. A. Dutt and I measured off a rod of land in the parish of Santon not far south-east of Grimes Graves. It was on a "breck" probably ploughed about ten years ago. Furrows divided it into ten strips. Of these the six nearer the river were extremely productive, the upper four not to nearly so great a degree. Our measurement was made on the seventh strip from the river, on which we found far fewer implements than on the strips lower down. We counted every piece of chipped flint lying on the surface of the rod we had enclosed. There were no really first-class implements, but those which were undoubtedly of human workmanship were: 1 chisel, 2 hollow scrapers, 4 borers, 5 scrapers, 5 large implements, 10 knives, 28 flakes, and 74 chips, a total of 129. Taking this as an average of the purely surface implements on one square mile of "breck" land, we get the astounding total of 13,209,600 worked flints. There are many miles where similar totals could be obtained and the various horizontal layers would add incalculably to the number. Leaving out of account the flakes and the chips, evidence that the implements were manufactured on the spot, probably of flint obtained from Grimes Graves, the number of implements on the rod was 27, which gives 2,764,800

to the square mile or 4320 to the acre. From this enormous number of implements it is obvious either that there must have been a large population, or the locality must have been occupied for a very lengthy period. All the evidence favours the latter hypothesis. It is very probable that many of these sandy sites were used after the introduction of the culture of the Bronze age, and it is noteworthy that at Weeting, Santon, Rushford, West Harling, Harpley, and Broome, as well as on the Suffolk banks of the Waveney and Little Ouse, and the heathland country round Woodbridge, Neolithic implements of the most delicate type are found in the immediate neighbourhood of round barrows, possibly of the Bronze age.

(4) Implements of polished flint or other stone, or made of igneous or other rocks. The Iberian farmers of the Neolithic age appear to have settled chiefly on the hill-tops and gradually extended cultivation down the slopes. The succeeding Goidels of the Bronze age, however, planted their homesteads in the fertile valleys. It can now hardly be doubted that throughout the Bronze age, stone implements of certain kinds were still utilised, and probably the big polished axes—magnificent specimens of which are in the Fitch Room of the Norwich Castle-Museum—perforated axes, and hammers of various kinds of stone were first used. Implements chipped and afterwards rubbed may mark the transitional stage between sandy site implements solely chipped and implements solely rubbed. With boulder clay and sandy site implements it is possible for a prehistoric archæologist to say whether it is likely they will be found in certain localities, and as a rule these forecasts are justified by events. Polished implements appear, however, to be discovered by accident. Though there are over eighty Norfolk localities for polished implements, they each represent but a few specimens—in most cases only one—while in some of the parishes where there are sandy sites thousands of implements have been found.

VI.

HOLOSTEUM UMBELLATUM, L., STATICE RETICULATA, L., & PHLEUM BOEHMERI, Wibel.

By A. Bennett, F.L.S.

Read 30th January, 1906.

In the above we have three more East Anglian species, that are decreasing, so far as counties are concerned.

Still Holosteum has been found in Surrey, and recorded* by Mr. C. E. Salmon, to whom I am indebted for specimens.

In a lately established weekly paper, 'The Country-Side,' (which though containing many interesting notes) there are suggestions for growing our rarer plants and planting, or sowing them in wild places. So long as this was only done in gardens no harm could happen, but the other suggestion is full of future trouble, and cannot be too widely known and deprecated. This planting has been done near London, and in the New Forest, but these are fairly well known, and can be ignored in Lists, &c.

Of the species here treated *Statice reticulata* is probably extinct except in Norfolk: no recent records of its occurrence in Lincoln, or Cambridge are extant. Though so restricted it is abundant where it does occur in Norfolk. Why it should be lost in Lincoln does not seem easy to explain unless the constituents of its former habitats are altered. We read it occurred "where the sheep bite close." I have never seen sheep in Norfolk in the places where it grows.

I now give the records of these species.

* In 'Journal of Botany,' 189 and 217, 1905.

HOLOSTEUM UMBELLATUM, Lin. Sp. pl. ed. 1. 88, 1753.

UMBELLIFEROUS JAGGED CHICKWEED.

Syme in Eng. Bot. ed. 3.

UMBELLATE HOLOSTEUM.

UMBELLIFEROUS CHICKWEED.

First Record. On the city walls of Norwich, first noticed by Mr. John Pitchford* in spring, 1765. Old walls, banks and sandy cornfields about Norwich. Rose's Elements of Botany, 447, 1775.

In 17. SURREY.

Old walls and in a field near by in the westerly portion of the county. Miss Cardew, 1905.

25. SUFFOLK E.

Ruins of Hoxne Abbey, sparingly. Collins in Fl. Suff. 81, 1889 Galpin's Flora of Harleston, 54, 1888.

Eye, May, 1836. Herb. Mrs. Casbourne, Fl. Suff. *l.c.* Hon. Anne Townsend, May, 1838, sp. figured by Baxter t. 299 in his Brit. Phan. Botany.

26. SUFFOLK W.

"Bury, on the wall leading from May Water Lane to Southgate Street. This is a plant not mentioned by any author as growing wild in England, except by Gerard." Friday, 23rd April, 1773. Sir J. Cullum in Fl. Suff. *l.c.*

Formerly grew on thatched roofs just beyond the Railway station, Northgate, Bury, Henslow and Skepper. Fl. Suff. 13, 1860.

Old walls, Bury. Sir J. Gage, 1800.

May, 1803. J. Dalton, 1885. J. Ibbotson† I suppose, Sir J. Cullum's reference is to Gerard's Herball emend. by T. Johnson, 1636, under the name of "*Caryophyllus holosteus arvensis*"; as I can find no such plant named in Gerard's Catalogue of Plants cultivated in the garden, in the years 1596–1599.

27. NORFOLK E.

* Died at Norwich, 22nd December, 1803. A.L.S., 1788. F.L.S., 1797. Biog. Index Brit. Bot., 136, 1893.

† York. Phil. Soc. *Herbarium.*

Norwich walls, near Magdalen Gate, 1779. J. E. Smith in M. S. List of Norf. pl. in Library of Linnean Society ; existed here up to 1879. H. D. Geldart.

On the city walls between St. Augustine's and Magdalen Gates ; between Magdalen and Pockthorpe Gates : near the back of Mr. G. Maltby's garden : Mr. Carter's garden wall at Thorpe. Notes by Crowe in Hudson's Fl. Angl. at Lin. Society.

Walls near the Close, 1801. Herb. Smith !

On several walls and roofs about Norwich, especially in the northern part of the town. Smith, Eng. Fl. 1.

1824. Walls at Norwich, May. 1820. W. Bean sp. in herb. Wilkinson.

Walls in St. Faith's Lane. Mr. Pitchford. Bot. Guide. 624, 1805.

Rev. R. Trimmer, sp. "In 1859 the wall on which it grew was scraped and repointed, and since that date I have not observed a single plant." Fl. Norf., 25. 1866.

Used to grow on an old wall in Bishopgate Street, now pulled down. Miss Geldart.

Yarmouth, St. Nicholas. M. S. Fl. of Norf. by S. P. Woodward, in possession of this Society teste Miss Geldart.

Wall near the New Mills in 1887, pulled down the following year. H. D. Geldart.

21. MIDDLESEX.

Walls of Chelsea Physic Garden.

72. DUMFRIES.

Hollywood village, 3 miles N.N.W. of Dumfries. Stat. Acc. of Scotland, 1843. Not noticed by Mr. Scott-Elliot in his Fl. of Dumfries, 1896.

Distribution. The whole of Europe (except Corsica, Sardinia, Ireland, Scotland, Norway, Sweden and N. Russia), India, Brit. Baluchistan, Turcomania, Syria, Mesopotamia, Persia, Transcaucasia, Algeria, Mauritius.

2. STATICE RETICULATA. Lin. Sp. pl. 275. 1753.

S. CASPIA, Willd. Enum. hort. ber. 1. 336. 1809

LIMONIUM RETICULATUM Miller, Gard. Dict. 8. No. 9. 1768.

First Record. "*Limonium minus flagellis tortuosum* (Boccone Mus. 2. t. 103, 1697) found on the coast of Norfolk by Mr. Henry Scott." Blackstone Spec. Bot. 47, 1746.*

27. NORFOLK E.

Cley. Mr. Crowe, 1805. Salmon, herb. 1809.

Whitear, 1834. G. Clowes sp. c. 1844.

Marshes due N. of Blakeney church, Mr. Crowe.

Salthouse. Trimmer, Supp. Fl. Norf., 49, 1884.

28. NORFOLK W.

Holme-next-the-Sea. Rev. Sutton, circa, 1801.

Babington, 1862. A. Bennett, 1876.

About Wells and Brancaster. From Brancaster Staithe to the town a hundred acres of ground might be found covered with it ; at Holme and Snettisham ; at Wells 60 yards west of the old Sluice made by Sir C. Turner, on the south side of the banks and the port. Crowe in Hudson's Fl. Anglica *l.c.* Geldart, 1892.

Holkham. Herb. Dillenius at Oxford ! c, 1730.

Wells, Wigham, Notcutt sp. 1864. Geldart, 1887. A. Bennett, 1900.

Burnham Overy. Miss Bell, Bot. Guide, 1835. Messrs. Groves, sp. 1903.

Burnham Deepdale. Geldart, 1892.

Heacham. Dr. Lowe.

Hunstanton. M. A. Lawson, 1866. A. Bennett, 1877.

Titchwell. Burnham Norton. Trimmer, Fl. Norf., 1866 ; Warham, 1867 ; Stiffkey, 1875. Trimmer, Supp. Fl. Norf., 1884.

29. CAMBRIDGE.

Tydd Marsh. Mr. Skrimshire, Bot. Guide, 50, 1805. Below Wisbech. Rev. J. Hemsted, July 27, 1795, who sent the sp. thence, figured in Eng. Botany, t. 328, ed. 3. t. 1561.

By the river side recently. Mr. A. Peckover in Babington's Fl. of Camb., 192, 1860. Sp. in Brit. Mus. Herb. "Sept., 1796, J. Sowerby."

53. LINCOLN S. District 17

* Is anything known of this Mr. Scott? His name does not appear in the Biog. Index of Brit. and Irish Botanists.

"On the salt marshes near Frieston, Leverton, &c." Sir J. Banks, Bot. Guide, 388, 1805.

54. Lincoln N. District 12.

"Fossdyke Wash; it grows on the level grassy land where the sheep bite close." Sir J. Banks in Herb. Brit. Museum! It was sought in 1829 at Frieston by Dr. Howitt without success.* "Extinct I believe." Rev. Woodruffe-Peacock in Naturalist, 101, 1895. I have been unable to see, or hear of any specimen since 1805. I do not find in the remarks of Dr. Lees,† or Woodruffe-Peacock any reason given (if any is apparent) why it has become extinct. The Norfolk stations must be as old as the Lincoln, yet it there maintains its ground.

25. Suffolk E.

Reported in Babington's Man. of Brit. Botany, ed. 3, 262, 1851 to the 6th, 1867; but in the 8th, 1881, it does not appear. Dr. Hind in his Fl. Suff., 287, 1889, remarks, "Our enquiries on the subject lead to the conclusion that it has been erroneously given for it." There is no note on this in Prof. Babington's account‡ of his journey to Orford and Aldborough, &c., and I saw no signs of it on the coast from Thorpe Ness to Orford.

Matted Sea-lavender.

Distribution. All round the coasts of the Mediterranean and Black Seas, and in E. Asia.

Nyman in his Consp. Fl. Europ., 612, 1881, calls this *S. reticulata*, Smith, and places it as a sub-sp. of *S. bellidifolia*, Gouan. But Sir J. D. Hooker and Mr. Bentham refer it to the *reticulata* of Linnæus, which was founded on Maltese specimens.

Phleum Boehmeri, Wibel, Prim. Fl., Werth, 125, 1799.

P. phalaroides, Koeler. Descrip. Gram. 52, 1802.

Phalaris phleoides, Linn., Sp. pl. 55, 1753.

European Floras generally adopt Wibel's name, but Sir J. D. Hooker in Stud. Fl. ed. 3, 476, says, "Schrader not of

* Watson's Bot. Guide, 651, 1837.

† Outline Flora of Lincolnshire, 1892.

‡ 'Journal of Life,' 112, 1842.

Wibel." Nyman *l.c.* says the Wibel's plant is a var. of *pratensis;* if this is so, of course Wibel's name cannot be used. Although the grass has been discovered in one or two localities in late years, yet it is really decreasing, as it is certainly gone in some of the Cambridge localities; in the old localities in Herts it is gone, and I could not find it on the Bartlow Hills in Essex, but these have been partly returfed by the owner, and access to them denied to the public. It is still in fair quantity at Hildersham, Cambs, where I gathered it on June 12th, 1905. Some of the specimens had the spikes lobed, and if the spike is drawn through the fingers the reverse way, this is at once shown, and will separate it from *P. pratense* at a glance. In *Boehmeri* the nodes are pale, scarcely darker than the rest of the stem, while in *pratense* they are much darker.

First Record. "*Phalaris phleoides* on Newmarket Heath." Relhan Fl. Cantab., 23, 1785. In his 3rd ed. (1820) he does not mention this locality.

Purple-stalked Cat's tail-grass.

Cat's-tail Canary grass. With. ed. 7. 142, 1830.

19. Essex N.

On the Bartlow Hills near Linton. Prof. Henslow in Gibson's Fl. Essex, 361, 1862.

Near Saffron Walden. J. Backhouse, 1846, in herb. C. E. Salmon.

20. Herts.

Near the Hertford Union Workhouse on the steep gravelly bank of the road to Stanstead, and in the plantation, now scarce but probably more plentiful before the spot was planted.

In a gravel pit between Holwell and Hatfield. Coleman and Webb. Fl. Herts, 325, 1849.

Between Wilbury Hill and Ickleford. Blow and Groves, sp.

26. Suffolk W.

Chalk pits and heaths S. of Eriswell. F. Townsend, Phytologist, 2, 584, 1846.

Codson Hill near Eriswell. Sir C. J. F. Bunbury, sp. 1846. Mildenhall on the northern part of the Warren Hill near

Brandon, also on the high ground beyond Barton Mills towards Herringswell. Sir C. J. F. Bunbury. Mildenhall, 1903. A Wallis in herb. C. E. Salmon.

Weather Heath and Lakenheath Warren. A. Bennett.

Troston Heath. Dr. Hind, 4, 8, 1892.

Extinct on Haberdon, Bury, and Kentford, Henslow and Skepper, Fl. Suff., 96, 1860.

Icklingham. Mr. Jordan; but the specimens he sent me thence are *P. arenarium*.

27. NORFOLK E.

Hardingham. Trimmer, Fl. Norf., 167.

28. NORFOLK W.

"Found at Narborough, July, 1780, in company with Mr. Woodward," Crowe in Fl. Anglica, *l.c.* "We found it in tolerable plenty towards the termination of the plantation by the side of the road leading from Narborough Hall to Marham." Knapp. Gram. Brit. ed. 2.

Narborough Field sp. in herb. Rev. H. Davies!

,, ,, Wardale. July, 1850.

Gayton near Lynn. Wardale in herb. Salmon.

Beachamwell. Miss Bolton in Trimmer's Fl. Norf., 167, 1866.

Swaffham, 1872; Brisley, 1876; Ringstead, 1880. Trimmer supp. 67.

Flitcham, N.E. of Lynn. Dr. Lowe teste Miss Geldart. Harling to Knettishall; Thetford to Rushford. Rev. E. F. Linton. J. Botany, 272, 1900.

Mundford. Trimmer, Fl. Norf., *l.c.*

29. CAMBRIDGE.

Barrington Hill near Hildersham in great abundance. Relhan. Fl. Camb. ed. 3, 26, 1820. This is now ploughed up, and the plant extinct.

Newmarket Heath. Relhan, ed. 1, 1785.

Devil's Ditch. Rev. J. Fisher of Christ's College, Camb.

Chippenham Park wall. July 6, 1797. Rev. J. Hemsted, who sent the sp. figured in Eng. Bot. t. 459 (March 1, 1798).

Hedgebanks beyond Bottisham on the Newmarket Road, 1839. Herb. Hailstone at York!

Hildersham Furze Hills. W. H. Coleman in Bot. New Guide, 601, 1837. In tolerable plenty on one of them (next Linton) and very sparingly on the roadside near them. June 12, 1905. J. and A. Bennett. But the roadside was being "pared" and I fear it is doomed. Babington in his Fl. Camb. quotes Smith's note* "In Cambridgeshire, Lyons, Herb. Banks," As Lyons died in 1775, he was the first to gather it in England.

30. BEDFORD.

Near Ickleford in great abundance. H. Groves, J. of Botany, 244, 1876. Just on the borders of Herts and Bedford at Willbury Hill near Ickleford, Hitchen. Blow and Groves in Record Club Rep., 185, 1876.

Reported from Gloucester (Buckman) and Kent (Mc Ivor), but never confirmed.

Distribution :—

Sweden, Norway, Denmark, Spain, France, Belgium, Germany, Switzerland, Italy, Austria, Greece, Russia, Siberia, Davuria, Algeria (Durand and Schinz. Consp. Fl. Af., 5. 815, 1895).

* Fl. Brit. 1, 63, 1800.

VII.

METEOROLOGICAL NOTES, 1905.

By Arthur W. Preston, F.R. Met. Soc.

Read 27th February, 1906.

January.

This was a fine month, with normal temperature, and about half the usual rainfall. It was the sunniest January for many years past, and snow fell on two days only. There were some seasonable frosts, but no great severity; there was, however, sufficient frost to allow of several days good skating on the marshes at Brundall. An excessively high state of the barometer prevailed during the last week, a maximum of 30.87 inches being reached on the 29th, this having been the highest reading recorded here since 1896. It was the eighth mild January in succession.

February.

On the mean the temperature was 40.5 degrees, or 2.3 degrees above the average. There were no very severe frosts. Rainfall was again somewhat deficient, but it was not such a dry month as January. Snow fell on six days, but to no great depth. Strong winds and gales from the north-east and east set in about the 19th, and continued for some days, and these were exceptionally penetrating and uncomfortable. Thunder occurred on the 26th and 27th.

March.

This was a fine, growing, genial month, with a mean temperature 4.5 degrees above the average, and, excepting

1903, it was the warmest March since 1882. Rainfall was about normal, and there was no snow. The warmth caused an early start of vegetation, but the season was not quite so advanced as in 1903.

April.

The month opened with mild weather, but on the 6th a cold, winterly spell set in, accompanied by snow, the amount of which was greater than at any time since the previous November. A short period of mildness in the middle of the month was followed by a second cold period with some more snow and sleet. Mean temperature was about 1 degree below the average, and 3.8 degrees lower than that of the previous April. There was much cloud at times, and rain fell on 24 days to the depth of 2.06 ins., which was .38 above the April average. Snow fell on 5 days, and thunder occurred on 2 days.

May.

On the whole, this was an ungenial month, although there was much sunshine at times. There was much cold, parching weather, and the wind was almost continuously north-easterly during the first three weeks. Rainfall was .44 ins. deficient. A great rise of temperature occurred on the 25th, and on the 29th the thermometer reached 80.2 degrees, or a higher point than had been attained in May for ten years past.

June.

Heavy storms of rain occurred at intervals, bringing up the rainfall of the month to 3.13 ins., or 1.23 ins. above the average. The weather was warm and close on many days, and there were many thunderstorms, particularly in the second half of the month. The worst of these storms in this vicinity occurred on the 17th, 26th, and 27th, the two former being severe in the Norwich district, and the latter in the more northern parts of the county. Mean temperature was 1.4

degrees above the average, which was the highest June mean since 1897, and the thermometer exceeded 70 degrees on nine days.

July.

This was a magnificent summer month, with much sunshine and great heat. Although the thermometer did not quite reach the readings it frequently does in warm summers, it, nevertheless exceeded 80 degrees on 7 days, and the mean daily maximum temperature was as high as 74.6 degrees. The night temperatures were also generally high, and the mean temperature of the month was 65.5 degrees, which was 4.1 degrees above the average, and higher than that of any July since 1876. The amount of rain measured at Brundall was .65 ins., only, constituting the driest July since 1897. The want of rain was severely felt at times, no less than 25 days being absolutely rainless.

August.

Although the mean temperature was in agreement with the average, there were no exceptionally hot days, nor, on the other hand, any very cool nights. There was but little rain during the first half of the month, and the dry period which set in on July 1st lasted for nearly seven weeks, during which only just over one inch of rain fell. The last week was very wet, and the heavy rains brought a great reduction in temperature, and there were many blustering, gusty days, which rendered the weather generally far less agreeable than in July.

September.

Showery weather occurred during the first week, and the month generally was less fair than what is usually expected at this season. On only two days did the thermometer exceed 70 degrees, and during the first half of the month variable winds from the S.W. and N.W. prevailed, and were strong and gusty at times. From the 16th to end of the

month the direction of the wind was almost continuously N.E. and E., and on many days these winds were very searching and rough. The weather in the middle of the month was dry, and some days were bright, but there was not much warmth after the 5th. Rainfall was .45 ins. deficient, and no rain whatever fell between the 9th and 24th, but there was a great downpour on the last-named day, lasting all night, measuring 1.05 ins. in the twenty-four hours.

October.

This was as unpleasant a month as could well be imagined. Not only was it very wet, but the rain was accompanied by much cold weather. The mean temperature of the month (44.8 degrees) was 4.5 degrees below the average, and it would appear that so cold an October had not been recorded in East Anglia since 1786, or a period of 119 years. It is true that colder nights and days have been chronicled in recent Octobers, and the mean temperature was nearly as low in 1817 and 1881, but a careful search into old weather records does not reveal a colder October on the mean since 1786. The two coldest weeks were those ending 21st and 28th, whose mean temperature were respectively 40.6 degrees and 40.8 degrees, or nearly 10 degrees below the average. Rainfall was 1.24 ins. in excess of the mean—but it is not a little remarkable that while it was so wet here, in nearly all other parts of the British Isles it was exceedingly dry, though very cold.

November.

Like October, temperature was low for the season, but the deficiency was relatively less. It was the coldest November since 1896, and there were seven successive nights with frost in the week ending the 23rd. Rain fell with considerable frequency, but the total fall was less than usual. Much chilly, damp weather prevailed, and on the morning of the 27th there was a gale of considerable violence from the S.W. A bright aurora was seen on the evening of the 15th

December.

Much dull, damp, foggy weather prevailed during the greater part of this month, with a long period of high barometer. There were no very sharp frosts, and a remarkable absence of snow. A drying east wind set in on the 31st, with frost. The mean temperature of the month was half a degree above the average, and the rainfall only about half the normal quantity for December.

The Seasons.

The following tables show the mean temperature and rainfall of the four seasons, together with those of the five previous years, compared with the usual averages. Winter comprises the three months December to February inclusive; Spring, March to May; Summer, June to August; and Autumn, September to November.

TEMPERATURE.

Seasons.	1900.	1901.	1902.	1903.	1904.	1905.	20-year average 1883-02.	Departure of 1905 from average.
	degrees.	degrees.	degrees.	degrees.	degrees.	degrees.	degrees.	degrees.
Winter ...	37.4	39.0	37.9	41.8	38.3	39.2	38.0	+1.2
Spring ...	45.3	46.3	46.3	47.3	47.8	47.5	46.3	+1.2
Summer ...	61.6	61.4	58.7	58.7	60.8	62.1	60.3	+1.8
Autumn ..	51.6	50.7	50.1	51.2	49.8	47.5	50.2	-2.7
Year ...	49.6	48.8	48.4	49.5	49.3	49.0	48.7	+0.3

RAINFALL.

Seasons.	1900.	1901.	1902.	1903.	1904.	1905.	38-year average 1865-02.	Departure of 1905 from average.
	in.	in.	in.	in.	in.	in.	in.	in.
Winter ...	7.42	5.88	6.09	3.64	5.96	4.91	5.96	-1.05
Spring ...	4.26	5.10	6.77	5.83	4.59	5.29	5.27	+0.02
Summer ...	8.77	3.61	7.82	10.54	4.70	6.05	6.94	-0.89
Autumn ...	5.32	5.11	4.14	9.77	4.98	8.11	8.01	+0.10
Year ...	26.99	21.06	22.30	29.44	21.50	22.96	26.18	-3.22

It will be seen that the winter and spring were each about one degree above the average temperature, the summer nearly two degrees above (being the warmest summer, on the mean, since 1884), and the autumn 2.7 below the normal, constituting the coldest autumn since 1887. The winter's rainfall was about an inch deficient, that of the spring about normal, the summer, owing to the dry July, was .89 under average, and the autumn very slightly above it.

The Year

The mean temperature of the year was 0.4 degrees above the average. The warmest months (relatively) were February, March, and July, and the coldest October and November. The other months approximated the average. The rainfall of the year was about three and a quarter inches below the mean, but an inch and a half in excess of that of the previous year. June and October were the wettest months, but the rainfall of January and July was less than an inch, and that of December but slightly exceeded that quantity. The winter was mild, and the spring variable. The summer was a remarkably fine one, with a steady heat throughout, without exhibiting any great extremes. The autumn was generally cold and chilly, and unusually damp. Harvest commenced about August 2nd. The fruit crop generally fell far short of the fine display of the previous year.

N.B.—The above observations were taken at Brundall, Norfolk, from January 1st to September 30th, afterwards (rainfall excepted) at Eaton, Norwich. The rainfall results throughout the year are given from Brundall. The instruments had their periodical inspection on September 6th from the Royal Meteorological Society's Inspector, who also viewed the new station at Eaton, with which he expressed his satisfaction.

Month.	Barometer.					Thermometer.					Hygrometer.	Cloud.	Rainfall.		Wind.								
	Highest.	Date.	Lowest.	Date.	Mean.	Highest.	Date.	Lowest.	Date.	Mean.	Mean Relative Humidity. 9 a.m.	Estimated Proportion	Inches.	No. of Days.	Direction.								Mean estimated force
															N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	
	in.		in.		in.	°		°		°	%												
Jan. .	30.87	29	29.20	17	30.233	52.0	6	21.4	2	37.7	91	6.1	.93	15	1	0	3	3	1	2	14	7	3.0
Feb. .	30.52	8	29.15	27	30.116	53.8	5	26.8	8	40.5	90	6.7	1.43	19	2	3	1	0	3	4	9	6	3.7
March .	30.30	3	29.07	15	29.735	60.0	22	24.0	4	45.4	82	6.1	1.82	21	0	2	1	4	7	7	7	3	3.7
April. .	30.27	1	29.32	11	29.835	64.0	14	27.0	8	45.5	82	7.7	2.06	24	1	2	6	3	1	6	5	6	3.9
May .	30.44	5	29.45	1	30.128	80.2	29	33.6	23	51.7	72	5.7	1.41	12	9	9	1	0	1	6	4	1	3.3
June .	30.42	23	29.71	17	29.963	77.3	16	42.6	1	59.8	76	6.0	3.13	16	1	11	7	0	3	5	3	0	3.4
July .	30.27	3	29.70	23	30.027	82.6	14	48.8	7	65.5	70	5.6	.65	6	3	4	0	2	2	1	10	9	2.8
Aug. .	30.27	31	29.23	28	29.892	77.2	21	46.0	21	61.0	73	6.9	2.27	18	2	0	2	3	8	6	7	3	3.4
Sept. .	30.38	17	29.51	10	29.943	74.0	3	41.0	15, 17	56.7	81	6.6	2.02	13	7	4	5	0	1	3	7	3	3.5
Oct. .	30.46	11	29.20	31	29.967	58.4	9	28.8	26	44.8	88	7.4	4.14	26	5	0	0	0	1	4	2	19	3.0
Nov. .	30.25	18	28.91	26	29.690	54.2	26	23.6	21	41.0	93	7.0	1.95	19	1	1	5	0	12	5	1	5	3.0
Dec. .	30.83	12	29.27	29	30.208	55.4	7	28.4	11	39.0	94	7.5	1.15	16	1	0	2	2	10	8	6	2	1.9
Means					29.978					49.0	83	6.6	22.96										3.2
Extreme & Totals.	30.87	Jan. 29th.	28.91	Nov. 26th.		82.6	July 14th.	21.4	Jan. 2nd.					205	33	36	33	17	50	57	75	64	

VIII.

SUFFOLK FUNGI.

By Rev. E. N. Bloomfield, M.A.

Read 27th February, 1906.

As I have already published lists of the Mosses, Hepatics, and Lichens of Suffolk, I think it may not be amiss to give also a list of the Fungi.

Thus far the only list of the Fungi of the county is contained in Henslow and Skepper's 'Flora of Suffolk,' which is good and for the most part perfectly reliable. This list is almost entirely due to Mr. Skepper, who for several years collected diligently about Bury, and was assisted very materially by the Rev. M. J. Berkeley, at that time our great authority on the Fungi. To show how assiduously Mr. Skepper collected, especially in 1856, I in many cases give the dates from the notes in his copy of the sixth volume of the 'English Flora.' The records from the East of the County are mostly from Mr. Stock of Bungay, and from myself, as I then resided at Great Glemham. Some of the latter records I have reason to believe are doubtful or incorrect, these, therefore, I shall omit. In later years, Dr. Hind, the author of the 'Flora of Suffolk,' 1889, collected a good number of the larger species, many of which were determined for him by Mr. Worthington Smith, and a few by Dr. Cooke. To many of the species which were thus determined I add their names as a guarantee of correct determination.

For records of some of the rarer species we are indebted to Dr. Badham, the author of the 'Esculent Funguses of England,' who resided at East Bergholt; these records are for the most part contained in the papers of the Rev. M. J. Berkeley, in the 'Annals of Natural History.'

Although the Fungi are of small economic importance as articles of food, yet on the other hand they are often very destructive to our timber, corn crops, and garden produce, &c. The only species of general consumption used in this country as a general article of diet are the Common and Horse Mushrooms, *Agaricus campestris* and *arvensis*, which are both wholesome and much esteemed: these are very nearly allied, and are not very generally distinguished. The Morel and Truffle are for the most part scarce in this country, though well known as choice articles of food; many other species are esteemed on the Continent, such as the Fairy-ring Champignon, the Cantharelle, &c., but are very seldom even tasted in this country except by Fungus eaters.

As is well known many species are very poisonous, even a small piece producing very severe illness or even death. Some of the larger species are very destructive to timber, while many of the small kinds greatly injure our crops, such as the Potato Blight, the Corn Mildew, Hop Mildew, Smut and Bunt in corn, &c. It was at one time supposed that the larger Fungi such as Agarics, Polypori, &c., only attacked previously diseased stems of trees; but though the spores may only gain access through injuries or decay, the mycelium spreads into the living tissue and thus kills the surrounding healthy part, and even the whole tree.

Another point worth mention is the very restricted nature of the matrix on which some alone will grow. Thus *Agaricus mucidus* only grows on beech, *Polyporus betulinus* on birch, *Polyporus dryadeus* on Oak, *Boletus laricinus* under Larch trees: while many others show a marked preference for one particular species of tree, as *P. squamosus* for Ash. *P. giganteus* for Beech, *P. sulphureus* and *Fistulina hepatica* for Oak, while others are not at all particular, but attack many species of trees. The same is true of the smaller Fungi.

The North-Eastern part of the County, like the adjacent portion of Norfolk, is noted among mycologists for the very rare *Trichogastres—Batarrhea* and species of *Geaster*, which have occurred there and have been recorded by Messrs. Woodward, Sowerby, &c.

No one since Mr. Skepper's death in 1867 has paid much attention to the smaller species, and hence I do not give them here, but refer to the list in the Flora. The sub-genera of Agaricus are printed as true genera, but the scientific names have not been altered but agree in gender with Agaricus.

The nomenclature and arrangement are, with few exceptions, those of Cooke's Handbook of British Fungi.

The abbreviations are as follows :—

E. N. B. The Rev. E. N. Bloomfield, Guestling, Sussex.
Dr. H. The late Rev. W. M. Hind, LL.D., Rector of Honington, and Author of 'The Flora of Suffolk,' 1889.
Fl. 'Flora of Suffolk,' Henslow and Skepper, 1860.
E. S. The late Mr. E. Skepper, Bury St. Edmunds.
W. G. S. Mr. Worthington G. Smith, F.L.S., the well-known fungologist.

HYMENOMYCETES

AGARICINI.

AGARICUS

AMANITA VIROSUS, Fr. Bungay, Aug., 1865, Cooke's Illustrations.
,, VAGINATUS, Bull. Great Glemham, Honington, &c.
,, PHALLOIDES, Fr. Common. Very poisonous
,, MUSCARIUS, L. FLY AGARIC. Very handsome. Fir woods common, Fl. Great Glemham, scarce, E. N. B.
,, STROBILIFORMIS, Fr. Great Glemham, Oct. 1887, E. N. B.
,, RUBESCENS, P. Frequent.
,, ASPER, Fr. Hardwick, in a wood, Fl.

LEPIOTA PROCERUS, Scop. Common.
,, RACHODES, Vitt. Great Glemham, E. N. B. Troston Mount, W. G. S.
,, ACUTESQUAMOSUS, Wm. (Mariæ). Bury, Fl.
,, CLYPEOLARIUS, Bull. Rougham, Fl., Honington, Dr. H.
,, CRISTATUS, Fr. Common.

LEPIOTA CEPÆSTIPES, Sow. Frequent in stoves, Fl. Marlesford, on tan, E. N. B.

„ GRANULOSUS, Batsch. Common, Fl.

ARMILLARIA MELLEUS, Vahl. Common on stumps. "Very destructive to nearly all kinds of orchard and other trees, including conifers." Massee.

TRICHOLOMA EQUESTRIS, L. East Bergholt, Dr. Badham.

„ NICTITANS, Fr. East Bergholt, Dr. Badham.

„ RUTILANS, Schœff. Stumps not uncommon, Fl. Great Glemham, E. N. B.

„ VACCINUS, P. East Bergholt, Dr. Badham.

„ TERREUS, Schœff. Common in woods, Fl. Otley and Great Glemham, E. N. B.

„ SCALPTURATUS, Fr. (argyraceus). Borders of woods, frequent, Fl.

„ CARTILAGINEUS, Bull. East Bergholt, Nov. 1855, Dr. Badham.

„ SULPHUREUS, Bull. Woods near Bury, Fl.

„ ARCUATUS, Bull. Fakenham, W. G. S.

„ ACERBUS, Bull. Suffolk, Dr. Badham.

„ GRAMMOPODIUS, Fr. Troston Mount, W. G. S.

„ SUBPULVERULENTUS, Pers. Troston Mount, W. G. S.

CLITOCYBE NEBULARIS, Batsch. (canaliculatus). Beech woods, Westley, Fl.

„ ODORUS, Bull. Santon Downham, Sept., 1856, E.S. Sapiston and Mellis, Dr. H. Benhall, E. N. B.

„ CERUSSATUS, Fr. Hardwick Heath, Fl.

„ CANDICANS, Fr. Beech wood at Bury. Fl.

„ DEALBATUS, P. Fakenham, W. G. S.

„ GALLINACEUS, Scop. Great Glemham, E. N. B.

„ MAXIMUS, Fr. Santon Downham. Fl. Honington, Dr. H.

„ INFUNDIBULIFORMIS, Schœff. Woods frequent, Fl.

„ GEOTRUPUS, Bull. Woods frequent, Fl. Great Glemham, E. N. B.

CLITOCYBE FLACCIDUS, Sow. Fir plantations, frequent, Fl.
,, ,, var. LOBATUS (fimbriatus, b). Hardwick Heath, Fl.
,, CYATHIFORMIS, Fr. Near Bungay, Mr. Woodward. Pastures and woods frequent, Fl.
,, FRAGRANS, Sow. Westley, Sept., 1854, E. S. Fakenham and Ixworth Thorpe, Dr. H.
,, LACCATUS, Scop. Common. The bright amethyst variety is very pretty.
,, PHYLLOPHILUS, Fr. Woods about Hardwick Heath, Fl.
PLEUROTUS ULMARIUS, Bull. On Elms at Bury, Oct., 1856, E. S.
,, SUBPALMATUS, Fr. On squared timber at Bury, Sept., 1856, E. S. Great Glemham, E. N. B.
,, FIMBRIATUS, Bolt. East Bergholt, Jan., 1852, Cooke's Illustrations.
,, OSTREATUS, Jacq. Bury, Great Glemham and Honington.
,, ACEROSUS, Fr. Hitcham, Professor Henslow.
COLLYBIA RADICATUS, Relh. Frequent, Fl. Mettingham and Homersfield, Mr. Woodward.
,, LONGIPES, Bull. (pudens). Great Glemham once, E. N. B.
,, FUSIPES, Bull. Common.
,, MACULATUS, A. & S. Barton Park, Fl
,, BUTYRACEUS, Bull. Honington, Dr. H.
,, VELUTIPES, Curt. Very common.
,, CONFLUENS, P. Woods somewhat common, Fl.
,, STIPITARIUS, Fr. Fakenham, Dr. H.
,, CONIGENUS, P. Hardwick, on Fir Cones, Oct., 1856, E. S.
,, DRYOPHILUS, Bull. Honington, W. G. S. Great Glemham, Fakenham, &c.
,, EXSCULPTUS, Fr. Suffolk, Dr. Badham.
,, TENACELLUS, P. Honington, Dr. H.
,, ESCULENTUS, Jacq. Fakenham, Dr. H.

Mycena purus, P. Common, Fl. Honington, W. G. S.
,, strobilinus, Pers. Newmarket, Rev. J. Hemsted.
,, lacteus, P. Westley, among moss, Oct., 1856, E. S. Honington, W. G. S.
,, galericulatus, Scop. Common.
,, polygrammus, Bull. Honington, W. G. S. Bury, October, 1856, E. S.
,, alcalinus, Fr. Hedges, &c., frequent, Fl.
,, galopus, Schrad. Woods frequent, Fl. Great Glemham, E. N. B.
,, epipterygius, Scop. Hardwick, on sticks, Fl.
,, corticola, Schum. Bury, on bark, Fl.
,, acicula, Schœff. (clavus). Bury, Fl.
Omphalia pyxidatus, Bull. Great Glemham, amongst short grass, E. N. B.
,, umbelliferus, L. Fakenham, W. G. S.
,, fibula, Bull. Among Moss, Bury, Fl. Sapiston, Dr. H.
Pluteus leoninus, Schœff. Bury, on sawdust. Oct., 1856, E. S.
,, phlebophorus, Ditm. Stowmarket, on sawdust, Fl.
Entoloma sinuatus, Fr. Great Glemham, 1884 and 1885. Very poisonous. W. G. S.
,, sericeus? Bull. (pascuus). Hardwick Heath, Fl.
Clitopilus prunulus, Scop. Great Glemham. E. N. B. Barningham Park, W. G. S.
Claudopus euosmus, Berk. East Bergholt. Berkeley's Outlines.
,, variabilis, P. Common on sticks.
Leptonia chalybœus, P. Honington, W. G. S.
,, incanus, Fr. (Sowerbei). Pasture at Nowton, Sept., 1856, E. S.
Nolanea pascuus, P. Honington and Barningham Park, W. G. S.
Pholiota præcox, P. Honington, W. G. S.
,, capistratus, Cooke. Honington, W. G. S.

PHOLIOTA SQUARROSUS, Müll. Frequent on timber.
,, ADIPOSUS, Fr. Swefling, E. N. B. Coloured like a ripe pineapple, a beautiful species.
,, MUTABILIS, Schœff. Honington and Troston Mount, W. G. S.
,, PUDICUS, Bull. Honington, W. G. S.
,, HETEROCLITUS, Fr. Great Glemham, on Poplar, E. N. B.
HEBELOMA SINAPIZANS, Fr. Great Glemham, 1884 and 1885.
,, CRUSTULINIFORMIS, Bull. Probably common.
,, FASTIBILIS, Fr. Common.
,, OBSCURUS, P. East Bergholt, Dr. Badham.
,, RIMOSUS, Bull. Woods, &c., common. Fakenham Wood, W. G. S.
,, GEOPHYLLUS, Sow. Woods, &c., common.
FLAMMULA FLAVIDUS, Schœff. Fakenham Wood, W. G. S.
,, SAPINEUS, Fr. Honington and Barnham, Dr. H.
CREPIDOTUS MOLLIS, Schœff. Common on timber.
NAUCORIA HORIZONTALIS, Bull. Mettingham, Mr. Woodward.
,, MELINOIDES, Fr. Common at Great Glemham.
,, SEMIORBICULARIS, Bull. Common.
,, SIPARIUS, Fr. East Bergholt, Dr. Badham.
GALERA TENER, Schœff. Hedge banks, frequent, Fl.
,, HYPNORUM, Batsch. Honington, W. G. S.
TUBARIA FURFURACEUS, P. Hardwick, on sticks. Honington, W. G. S.
PSALLIOTA ARVENSIS, Schœff. Horse Mushroom. Common.
,, ,, var. VILLATICUS, Brond. Suffolk, Dr. Badham.
,, CAMPESTRIS, Common Mushroom. Abundant.
,, ,, var. PRATENSIS, Vitt. East Bergholt.
,, ,, var. RUFESCENS, Berk. Great Glemham.
STROPHARIA ÆRUGINOSUS, Curt. Common.
,, OBTURATUS, Fr. Honington, W. G. S.
,, STERCORARIUS, Fr. Honington, W. G. S.
,, SEMIGLOBATUS, Batsch. Common.
HYPHOLOMA SUBLATERITIUS, Fr. Not unfrequent, Fl.
,, FASCICULARIS, Hud. Common.

HYPHOLOMA LACRYMABUNDUS, Fr. Fakenham Wood, W. G. S. Otley, E. N. B.

,, VELUTINUS, P. Great Glemham, E. N. B.

,, CANDOLLIANUS, Fr. Great Glemham, E. N. B. Fakenham Wood, W. G. S.

,, APPENDICULATUS, Bull. Great Glemham, E. N. B. Brandon, W. G. S.

PSILOCYBE SEMILANCEOLATUS, Fr. Hardwick Heath, Fl.

,, FŒNISECII, P. Great Glemham, somewhat common, E. N. B.

PANÆOLUS SEPARATUS, L. (semiovatus). Frequent.

,, FIMIPUTRIS, Bull. Frequent, Fl. Fakenham, W. G. S.

,, PAPILLIONACEUS, Bull. Pastures frequent, Fl.

PSATHYRELLA GRACILIS, Fr. Hedges about Bury, Fl. Fakenham, W. G. S.

,, ATOMATUS, Fr. Occasionally about Bury,

,, DISSEMINATUS, Fr. Common.

COPRINUS COMATUS, Fr. Common.

,, ATRAMENTARIUS, Fr. Common.

,, PICACEUS, Fr. Bury, on sawdust, Oct., 1856, E. S.

,, FIMETARIUS, Fr. Frequent.

,, NIVEUS, Fr. Frequent on horse dung, Fl.

,, MICACEUS, Fr. Common about stumps.

,, RADIANS, Fr. Bungay, 1866, Cooke's Illustrations.

,, RADIATUS, Fr. Frequent.

,, EPHEMERUS, Fr. Common on dung hills.

,, PLICATILIS, Fr. Common among grass.

BOLBITIUS TITUBANS, Fr. Near Mermaid pits, Bury, Oct., 1856, E. S. Honington, W. G. S.

,, FRAGILIS, Fr. Great Glemham, E. N. B.

CORTINARIUS PURPURASCENS, Fr. Great Glemham, E. N. B.

,, COLLINITUS, Fr. Great Glemham, E. N. B.

,, VIOLACEUS, Fr. Westley, Oct., 1856, E. S.

,, ANOMALUS, Fr. Great Glemham, E. N. B.

,, HINNULEUS, Fr. Great Glemham, E. N. B.

LEPISTA NUDA, Bull. Common, Fl. Fakenham, W. G. S.
,, PERSONATA, Fr. Common. Often in large rings.
PAXILLUS INVOLUTUS, Fr. Common.
,, PANUOIDES, Fr. Decayed timber at Bury, Sept., 1856, E. S. Bury, F. Norgate.
HYGROPHORUS HYPOTHEJUS, Fr. Fir wood at Fornham, Oct., 1856, E. S.
,, PRATENSIS, Fr. Common.
,, VIRGINEUS, Fr. Common.
,, CERACEUS, Fr. Great Glemham, E. N. B.
,, COCCINEUS, Fr. Common.
,, MINIATUS, Fr. Cavenham Severals, E. S.
,, PUNICEUS, Fr. Rougham heathy ground, Oct., 1856, E. S.
,, CONICUS, Fr. Very common.
,, PSITTACINUS, Fr. Common.
,, VITELLINUS, Fr. Ixworth Thorpe, Dr. H.
GOMPHIDIUS GLUTINOSUS, Fr. Great Glemham, E. N. B.
,, VISCIDUS, Fr. Common under Scotch Firs.
LACTARIUS TORMINOSUS, Fr. Westley, Oct., 1856, E. S. Great Glemham, E. N. B.
,, TURPIS, Fr. East Bergholt in plenty, Dr. Badham.
,, INSULSUS, Fr. Great Glemham, E. N. B.
,, BLENNIUS, Fr. Bury, in Beech woods, Fl. Great Glemham, E. N. B.
,, VELLEREUS, Fr. Common.
,, ,, var. EXSUCCUS, Otto. Great Glemham, E. N. B. Fakenham Wood, W. G. S.
,, PIPERATUS, Fr. Otley, E. N. B. Fakenham Wood, W. G. S.
,, PYROGALUS, Fr. Mellis, W. G. S.
,, DELICIOSUS, Fr. Fir woods not uncommon, Fl.
,, PALLIDUS, Fr. Great Glemham, 1884, E. N. B. Bardwell, W. G. S.
,, QUIETUS, Fr. Common, Fakenham Wood, W. G. S.

Lactarius fuliginosus, Fr. Great Glemham, E. N. B. Bardwell, W. G. S.

,, glyciosmus, Fr. Hardwick Heath, rare, Fl.

,, volemum, Fr. Great Glemham, E. N. B.

,, subdulcis, Fr. Great Glemham, 1884, E. N. B. Honington, &c., W. G. S.

Russula nigricans, Fr. Woods, frequent, Fl.

,, rubra, Fr. Rougham, under Oaks, Fl.

,, fœtens, Fr. Great Glemham, E. N. B. Probably not uncommon.

,, emetica, Fr. Sapiston, Dr. H.

,, integra, Fr. Great Glemham, E. N. B.

,, alutacea, Fr. Woods about Bury, Fl.

Cantharellus cibarius, Fr., Cantharelle. Hawstead, 1774. Sir J. Cullum. Great Glemham, E. N. B. Hitcham, Honington, &c.

,, aurantiacus, Fr. Rougham, October, 1856, E. S. Great Glemham, E. N. B. Fakenham, Dr. H.

Marasmius peronatus, Fr. Frequent, Fl. Flixton, Mr. Woodward. Honington, W. G. S.

,, oreades, Fr. Fairy-ring Champignon (Scotch Bonnets). Common.

,, ramealis, Fr. Bury, Fl. Fakenham Wood, W. G. S.

,, androsaceus, Fr. Hardwick, on dead leaves, Fl.

,, rotula, Fr. Common.

,, caulicinalis, Fr. Honington, Dr. H.

,, epiphyllus, Fr. Frequent, Fl.

Lentinus Dunalii, Fr. Rendham, on Ash, E. N. B.

,, lepideus, Fr. Honington, W. G. S.

,, cochleatus, Fr. Honington, W. G. S.

Panus stypticus, Fr. Common.

Schizophyllum commune, Fr. Felled trees at Bury, Oct., 1856, E. S.

Lenzites betulina, Fr. Common.

Polyporei.

Boletus luteus, L. Fir plantations. Common, Fl.
,, flavus, With. Great Glemham, E. N. B. Honington, Dr. H. Frequent, Fl.
,, flavidus, Fr. Ixworth Thorpe, W. G. S.
,, laricinus, Berk. Great Glemham and Nowton.
,, granulatus, L. Among Firs, Great Glemham, E. N. B. Bury, October, 1856.
,, bovinus, L. Honington, Dr. H.
,, sanguineus, With. Mellis, Dr. H.
,, variegatus, Fr. Fakenham, W. G. S.
,, chrysenteron, Fr. Great Glemham. Probably common.
,, subtomentosus, L. Mellis, Dr. H.
,, edulis, Bull. Common.
,, ? æstivalis, Fr. (pachypus). Great Glemham, E. N. B.
,, Satanas, Lenz. Great Glemham, 1884, E. N. B.
,, luridus, Schœff. Common. Turns blue instantly when broken.
,, scaber, Fr. Frequent.
,, cyanescens, Bull. Hawstead, Sept., 1856, E. S.
Polyporus lentus, Berk. Great Glemham and Farnham, E. N. B. Rougham and Lowestoft, E. S. Always on Furze stems.
,, rufescens, Fr. (Dædalea biennis, Bull). Otley, Great Glemham, E. N. B. Ickworth Park, Fl.
,, perennis, Fr. West Stow, Fl. Barton Mills, E. S. Belton, Dr. H.
,, squamosus, Fr. Common on Ash.
,, varius, Fr. Honington, W. G. S. Frequent on timber, Fl.
,, lucidus, Fr. Great Glemham, 1903, E. N. B.
,, giganteus, Fr. On Beech stumps, Great Glemham and Little Glemham, E. N. B.

POLYPORUS SULPHUREUS, Fr. Frequent, Fl. Great Glemham, E. N. B. Elvedon, &c., W. G. S. Usually on oak.

,, CÆSIUS, Fr. Near Newmarket, Rev. J. Hemsted, Sowerby.

,, ADUSTUS, Fr. Not uncommon, Fl. Great Glemham, Honington, &c.

,, HISPIDUS, Fr. Common on Elm.

,, CUTICULARIS, Fr. Livermere, W. G. S

,, DRYADEUS, Fr. Great Glemham and Helmingham, on Oak, E. N. B. Hardwick and Barton, Fl.

,, BETULINUS, Fr. Fritton Decoy, E. S. Honington, W. G. S.

,, FOMENTARIUS, Fr. Great Glemham. E. N. B., rare. Honington, Dr. Cooke.

,, IGNIARIUS, Fr. Common on Plum.

,, RIBIS, Fr. Great Glemham and Orford, E. N. B.

,, SALICINUS, Fr. Long Melford, W. G. S.

,, FRAXINEUS, Fr. Great Glemham and Otley, E. N. B.

,, ANNOSUS, Fr. Common. Very destructive to Conifers.

,, CONNATUS, Fr. Livermere, W. G. S.

,, FIBULA, Fr. Yoxford. On door of wine cellar, Mr. Davy, Sowerby.

,, VELUTINUS, Fr. Honington, Dr. H.

,, HIRSUTUS, Fr. Honington, Dr. H.

,, VERSICOLOR, Fr. Very common.

,, ABIETINUS, Fr. Common on dead Firs, Fl.

,, FERRUGINOSUS, Fr. Bury, Fl. Great Glemham, E. N. B. Honington, Dr. Cooke.

,, VAPORARIUS, Fr. Very common.

DÆDALEA QUERCINA, P. On Oaks, frequent, Fl. Great Glemham, E. N. B.

,, UNICOLOR, Fr. Frequent.

MERULIUS TREMELLOSUS, Schrad. Bury on timber, Fl.

,, CORIUM, Fr. Common.

MERULIUS LACHRYMANS, Fr. In cellars, &c., causing Dry Rot.
FISTULINA HEPATICA, Fr. Great Glemham, Bury, &c. On Oak.

HYDNEI.

HYDNUM IMBRICATUM, L. Bungay. Not uncommon, Mr. Woodward.
,, REPANDUM, L. Bungay, Mr. Woodward, Shrubland Park, Mildenhall, Fl.
,, AURISCALPIUM, L. Hawstead, Sir J. Cullum, 1774. Common.
,, ? sp. Great Glemham, bursting through the bark of an Apple tree, E. N. B.

AURICULARINI.

THELEPHORA CARYOPHYLLEA, Fr. Near Bungay Woods, abundant, Mr. Stock.
,, PALMATA, Fr. Hitcham Wood, Fl.
,, LACINIATA, P. Frequent in Fir woods, Fl. Fornham and Mildenhall, 1862, E. S.
STEREUM PURPUREUM, Fr. Common.
,, HIRSUTUM. Fr. Very common.
,, SANGUINOLENTUM, Fr. Great Glemham, E. N. B. Bury, Fl.
,, RUGOSUM, Fr. Great Glemham, E. N. B.
,, ACERINUM, Fr. Common on Maple bark, Fl.
HYMENOCHÆTE RUBIGINOSA. Lev. On Oak posts, frequent, Fl. Great Glemham and Fakenham.
,, TABACINA, Lev. About Bury on Hazel, December 1856, E. S.
AURICULARIA MESENTERICA, Bull. Common, Fl. Great Glemham and Benhall, E. N. B.
CORTICIUM GIGANTEUM, Fr. Bury, on felled Fir trees, Fl.
,, LÆVE, Fr. Honington, Dr. Cooke.
,, CŒRULEUM, Fr. Common. Very beautiful, like blue velvet.
,, OCHRACEUM, Fr. Bury. On fallen branches, Fl.

Corticium quercinum, P. Common.
,, cinereum, Fr. Common.
,, incarnatum, Fr. Botanic Garden, Bury, Nov., 1860, E. S. Honington, W. G. S.
,, nudum, Fr. Honington.
,, confluens, Fr. Honington, W. G. S.
,, polygonium, P. Honington, Dr. Cooke.
,, comedens, Fr. Common on dead branches.
,, sambuci, P. Common.
Cyphella galeata, Fr. On *Hypnum purum*, at Hardwick, 1856, E. S., and Bungay, Fl.
Solenia ochracea, Hoffm. (Peziza anomala). On wood about Bury, common. Fl.

Clavariei.

Clavaria amethystina, Bull. Shrubland Park. Kirby Trimmer.
,, fastigiata, D.C. Common in pastures.
,, muscoides, L. Hardwick Heath, Oct., 1859. E. S. Sapiston, Dr. H.
,, cristata, Holmsk. Frequent, Fl.
,, rugosa, Bull. Common, Fl.
,, abietina, Schum. Westley and Rougham, in Fir woods. Fl.
,, stricta, P. On sawdust at Bury, Fl.
,, inæqualis, Müll. Meadows about Bury, Fl.
,, vermiculata, Scop. Hawstead. 1772. Sir J. Cullum. Common.
,, acuta, Sow. Honington, Dr. H.
Calocera cornea, Fr. Common.
Typhula Grevillei, Fr. Decaying Alder leaves, Bury, Fl.

Tremellini.

Tremella foliacea, P. Ickworth Park on felled tree. Dec., 1856, E. S.
,, mesenterica, Retz. Common.
,, albida, Huds. Common.
,, intumescens, Sow. Honington, Dr. Cooke.

Tremella viscosa, Berk. Bury, on fallen branches, Fl.
Exidia recisa, Fr. Great Glemham, on Willows, E. N. B.
,, glandulosa, Fr. Common.
Hirneola auricula-judæ, Berk. Great Glemham, on Elm, E. N. B. Bury, Fl.
Dacrymyces deliquescens, Dub. Honington, Dr. Cooke.
,, stillatus, Nees. Common.
Ditiola radicata, Fr. East Bergholt, Dr. Badham.

GASTEROMYCETES.

Hypogæi.

Melanogaster? variegatus, Tul. (T. moschatum). Hardwick. Once in 1858, E. S.

Phalloidei.

Phallus impudicus, L. Not uncommon. Frequent near Bungay, Mr. Woodward. Great Glemham, Santon Downham, &c.
,, iosmus, Berk. Lowestoft sandhills, Curt.
Cynophallus caninus, Fr. Coddenham, Kirby Trimmer.

Trichogastres.

Batarrea phalloides, P. Sandhills near Bungay, Woodward. Mr. Davy finds it annually at Yoxford, Sowerby.
Tulostoma mammosum, Fr. Old walls at Bury, Fl. Honington, Dr. H.
Geaster coliformis, P. Sandbanks at Mettingham, Dickson.
,, fornicatus, Fr. Occasionally met with, Fl. Found frequently in Norfolk and Suffolk, Sowerby.
,, striatus, D.C. Sandy ground about Yarmouth and Bungay, Fl.
,, Bryantii, Berk. Sandy bank at Bury and about Bungay, Fl.

GEASTER LIMBATUS, Fr. In a Fir wood at Bury, Nov., 1857, E. S.

,, MAMMOSUS, Chev. Sandy ground, Santon Downham, Sept., 1856, E. S.

,, RUFESCENS, Fr. Fir woods, Bury, plentiful. Nov., 1857, E. S. Troston, Dr. H.

,, HYGROMETRICUS, P. In a sandy wood at Bury, Oct. 1856, E. S.

All these are well figured in the Transactions of the Norfolk and Norwich Naturalists' Society for 1872–73, p. 67–77.

BOVISTA NIGRESCENS, P. Sir J. Cullum. 1773. Rougham and Santon Downham, Fl.

,, PLUMBEA, P. Common, Fl. Little Glemham, E. N. B.

LYCOPERDON GIGANTEUM, Batsch. Not uncommon. Sometimes very large. When young the peridiam is like white kid leather.

,, CÆLATUM, Fr. Common.

,, ATROPURPUREUM, Vitt. Hardwick, in a wood, Oct., 1856, E. S.

,, SACCATUM, Vahl. Great Glemham, Oct., 1885, E. N. B.

,, GEMMATUM, Fr. Common.

,, PYRIFORME, Schœff. Not uncommon.

SCLERODERMA VULGARE, Fr. Somewhat common.

,, VERRUCOSUM, P. Common.

MYXOGASTRES.

LYCOGALA EPIDENDRUM, Fr. Frequent.

RETICULARIA UMBRINA, Fr. Frequent, Fl. Otley, &c.. E. N. B.

,, MAXIMA, Fr. Dalham, on Willow, 1864, E. S.

ÆTHALIUM SEPTICUM, Fr. Common on sawdust, &c.

SPUMARIA ALBA, D.C. Common.

DIDERMA VERNICOSUM, P. On grass occasionally, Fl. Great Glemham, E. N. B.

,, SPUMARIODES, Fr. Hardwick, on moss, Fl.

,, GLOBOSUM, Fr. Bury, on Oak leaves, Fl.

DIDYMIUM HEMISPHERICUM, Fr. Bury, on leaves, Oct., 1856, E. S.

,, SQUAMULOSUM, A. & G. Bury, on twigs, Fl.

,, FARINACEUM, Fr. Honington, Dr. Cooke.

,, NIGRIPES, Fr. Bury, Fl. Great Glemham, E. N. B.

PHYSARUM NUTANS, P. Frequent.

,, ,, var. AUREUM, P. Great Glemham, 1860, E. N. B.

,, ALBUM, Fr. Frequent on decaying wood, Fl.

ANGIORIDIUM SINUOSUM, Grev. Hardwick, on tan in hot house, Fl.

BADHAMIA HYALINA, Berk. Bury, on rotten wood, frequent, Fl.

,, FULVELLA, Berk. East Bergholt.

,, PALLIDA, Berk. East Bergholt.

,, NITENS, Berk. East Bergholt.

CRATERIUM MINUTUM, Fr. Hardwick Heath, Fl.

,, LEUCOCEPHALUM, Ditm. Bury, Fl.

STEMONITIS FUSCA, Roth. Common on rotten wood.

,, OVATA, P. Frequent, Fl.

ENERTHENEMA ELEGANS, Bowm. On decaying wood, Fl.

ARCYRIA PUNICEA, P. Frequent.

,, INCARNATA, P. Woolpit Wood, May, 1856, E. S.

,, NUTANS, Fr. Bury, frequent, Fl.

TRICHIA FALLAX, P. Great Glemham, E. N. B.

,, CLAVATA, P. Bury, on rotten wood, Fl.

,, TURBINATA, With. Bury, on rotten wood, Fl.

PERICHÆNA POPULINA, Fr. Bury, on fallen Poplars, Fl.

NIDULARIACEI.

CYATHUS STRIATUS, Hoffm. Near Bungay, Mr. Woodward. Perhaps not in Suffolk.

, VERNICOSUS, D.C. Common, Fl. Glemham, Otley, Honington, &c.

CRUCIBULUM VULGARE, Tul. Near Bungay, Mr. Woodward.

The above three species are common near Bungay, Mr. Woodward.

SPHÆROBOLUS STELLATUS, Tode. Bury, on rotten wood, Fl.

ASCOMYCETES.

Elvellacei

Morchella esculenta, P. Frequent, Fl. Hawstead, Sir J. Cullum, 1773. Great Glemham, Otley Honington.

,, semilibera, D.C. Great Glemham, 1848 and 1849, E. N. B. On road sides. Santon Downham, Fl.

Helvella crispa, Fr. Woods frequent, Fl. Great Glemham, E. N. B.

,, lacunosa, Afz. Woods about Bury, frequent, Fl. Bungay, With.

,, elastica, Bull. Otley, E. N. B. Bury, Oct., 1856, E. S.

Verpa digitaliformis, P. Great Glemham, April 1848 and 1851, on road-sides, sometimes with M. semilibera.

Spathularia flavida, P. Fir wood at Bury, Nov., 1857, E. S. Coney Weston, abundant every year, E. S. Corton Heath, Fl.

Leotia lubrica, P. Great Glemham, 1848, E. N. B. Woods at Hardwick, Fl.

Geoglossum glutinosum, P. Frequent, about Bury, Fl.

,, glabrum, P. Farnham, E. N. B. Rougham and Sapiston, Dr. H.

,, hirsutum, P. Hawstead, Sir J. Cullum, 1774. About Bury, Rougham Heath, Fl.

,, difforme, Fr. Rougham, Fl. Risby, E. N. B.

Peziza acetabulum, L. Frequent, Fl. Great Glemham, Bury, &c,

,, tuberosa, Bull. In a wood at Hardwick, Fl.

,, venosa, P. Great Glemham and Otley, E. N. B. Hawstead, Fl.

,, badia, P. Hardwick, 1859, E. S. Honington, Dr. H.

,, cochleata, Huds. Beech wood at Bury, Fl. Honington, Dr. H.

PEZIZA AURANTIA, Fr. Great Glemham, E. N. B. Horringer, Fakenham.

,, REPANDA, Wahl, Honington, Dr. H.

,, CEREA, Sow. Bury, on a hot bed, Fl. Honington, Dr. H.

,, CUPULARIS, L. Beech wood at Bury, Fl.

,, LANUGINOSA, Bull, var. Sumneri. Great Glemham, under a Cedar in plenty. E. N. B.

,, SEPULTA, Fr. East Bergholt.

For the rest of the *Elvellacei* see Henslow and Skepper's Flora.

TUBERACEI.

TUBER ÆSTIVUM, Vitt. Common Truffle, Bury, &c., in Beech woods, Fl.

SPHÆRIACEI.

TORRUBIA MILITARIS, Fr. (Isaria farinosa). Bury, on dead pupæ, Fl.

CLAVICEPS PURPUREA, Tul. Ergot. Near Hitcham, Professor Henslow.

EPICHLOE TYPHINA, Berk. Common on culms of grasses, Great Glemham, E. N. B. Honington, W. G. S.

HYPOCREA RUFA, Fr. (Trichoderma viride). Common on fallen trees.

,, ALUTACEA, Fr. Westley, under a Fir tree, Fl.

XYLARIA POLYMORPHA, Grev. Otley, E. N. B. Bury, E. S. Honington, Dr. H.

,, DIGITATA, Grev. Bury, on decaying wood, Fl.

,, HYPOXYLON, Grev. Abundant on stumps, &c.

,, CARPOPHILA, Fr. Common on Beech mast.

PORONIA PUNCTATA, Fr. Common near Bungay, Mr. Woodward. Aldeburgh, E. N. B.

USTULINA VULGARIS, Tul. Great Glemham, E. N. B. Fornham, on rotten stumps, Fl.

HYPOXYLON CONCENTRICUM, Grev. Frequent on Ash.

For the rest of the Fungi see Henslow and Skepper's Flora.

IX.

A PRELIMINARY SKETCH OF THE BIONOMICAL BOTANY OF SUTTON AND THE ANT DISTRICT.

By W. A. Nicholson, *Hon. Sec.*

Read 27th February, 1906.

The following observations refer, more especially, to the region marked in Mr. Balfour Browne's Map,* as the Ant district, though I have introduced a few remarks dealing with Hickling Broad District, where the prevailing conditions might be considered as fairly similar to Barton Broad. My work has been done, mainly in the summer months of 1902–04–05, supplemented by an occasional early spring, late autumn and winter visit. A complete survey of the botany of the district, would necessitate a residence there, for many months, perhaps even extending into years.

I have to thank Mr. Gurney, and his director Mr. F. Balfour Browne, for allowing me every facility for access to the Sutton Laboratory and the adjoining meadows and marshes.

The laboratory at Longmoor Point is about 4½ miles from the sea. It is situated on a tongue of higher land, which juts out into the alluvium of the marshes. This higher land, which is composed of pebbly gravel and sand, stretches from Longmoor Point in an easterly direction to Hickling Broad. It extends southerly to the east of Barton Broad. The same formation is represented on the southern and south-western edges of this Broad. On the western side of Barton Broad, towards Stalham, stony loam and sand occurs.

* Note.— See Map to vol. viii. p. 69, Trans. Norfolk and Norwich Nat. Soc. The district extends from Stalham to the south of Barton Broad, and includes Sutton and Barton Broads, a portion of the Ant, and the marshes adjacent to these localities. The flora of the higher land on the western part of the district has not been dealt with in this paper.

We are chiefly concerned here with the Alluvium, which covers most of the area now under consideration. The alluvium consists of silt or mud, clay, loam, sand, gravel, and peat. I am not aware of the depth of alluvium in the Ant Valley, but depths of valleys are given by Mr. H. B. Woodward for Wroxham, 72 feet, and Norwich, 42 feet. The depth at Potter Heigham has been stated as 56 feet, but I have unfortunately mislaid the reference.

It is well-known that some of the best agricultural land in England is situated in the district lying between Sutton and the sea.

Dr. James Geikie says, "Soils . . . . tend to travel down slopes, however gentle these may be." Therefore it does not seem unreasonable to suppose that the alluvial soil of the marshes contains many of the constituents of the rich soil of the higher ground.

Mr. H. B. Woodward refers in his 'Memoir of the Geology of the country around Norwich,' to an analysis of soil from Sutton made by Dr. Lyon Playfair, and reported in the Journ. Roy. Agri. Society, vol. vi., part II, p. 577. The note in the Journal is headed "Analysis of the Soil and Subsoil of a very Productive field near Sutton, in Norfolk." The date is 1845. Amongst other constituents the soil was found to contain 2.10 % of carbonate of lime, and a trace of chlorine, whilst the subsoil yielded .09 % of carbonate of lime, and 2.08 % of chloride of sodium. Dr. Playfair considered that the larger amount of common salt in the subsoil was only explicable on the supposition that it had been washed by the rains from the upper soil to the lower, and that the origin of the salt was due to the proximity to the sea. Rain-water falling in places near the sea has been found to contain a larger percentage of chlorine than when collected in inland situations.

It is not proposed in this paper to give a list of all the plants that have been found, but to draw attention especially, to those which are most characteristic of the marshy and aquatic regions of this part of the Broads' district.

There is very little, if any, of the kind of wet common, such as at Honing and East Ruston, represented here. This type

of wet common approaches more nearly to the true meadow, with its regular grass carpet. The carpet-formation of the marshes, where one exists, is mainly a moss-carpet. Kerner's definition of carpet is "low, perennial plants which form a close mat covering the ground." The grass-carpet would necessarily be found in drier situations. A near approach to a carpet is formed by the Marsh-cinquefoil (*Potentilla palustris*, Scop.), which overspreads considerable portions of the marshes.

In the main I have followed the nomenclature of the species in the 9th edition of the London Catalogue, 1895, though without adhering in all cases to the arrangement of that Catalogue. In the examination of the plant-associations of a district, one is not so much concerned with systematic arrangement of the plants, as with their relative abundance in particular positions.

Mr. A. Bennett, F.L.S., has kindly examined and confirmed the Lists of Characeæ and Potamogetons, quoted, and Mr. W. H. Burrell has furnished a list of Mosses and Hepaticæ, with some remarks upon them, which he has kindly allowed me to incorporate in this paper. I am also indebted to Miss A. M. Geldart for several suggestions.

The *Characeæ* are well represented in the Broad district. In the immediate neighbourhood of the Sutton Laboratory, six species, at least, have been found. These, which were growing in rather shallow water, were

Chara fragilis, Desv.
C. aspera, Willd.
C. polyacantha, Braun.
C. hispida, L.
Lycnothamnus stelliger, Braun.
Nitella opaca, Agardh.

Another species of Nitella, viz., *N. flexilis*, Agardh, was found between Stalham staithe and Barton Broad, by Mr. A. Bennett.

The occurrence of *Lycnothamnus stelliger*, Braun, here, is of special interest. It was first discovered in Britain at Filby and Potter Heigham by Mr. A. Bennett, and has since been

recorded in two or three other counties. Its extremely regular starch-stars, or bulbils, are characteristic of this species, and it is by them that the plant is mainly propagated, as it very seldom fruits.

In Barton Broad, there is an extensive growth of Characeæ, consisting (probably with other species) of

CHARA FRAGILIS, Desv.
C ASPERA, Willd., var. CAPILLATA, Braun.
C. VULGARIS, L.
,, var. PAPILLATA, Wallr.

The great abundance of the genus Chara in these waters, is an indication of the presence of a considerable quantity of calcium carbonate held in suspension, as the attraction for calcium carbonate shown by this genus is well known; the stems and, in some cases, the whole plant being covered with a dense calcareous incrustation. This seems to be even more conspicuous in the dead plant. Frequently, in passing over the surface of the water, one's eye is drawn to a whitish patch showing up amongst the dark green carpet of Chara covering the bottom. On closer examination it is seen to be the decaying remains of Chara, the green portion having disappeared, leaving the skeleton framework with its white covering of calcium carbonate.

The characteristic odour of *Chara* can be frequently detected in the air, above places where it is growing freely. Bennett and Murray, in their Handbook of Cryptogamic Botany, p. 181, state that "The presence of certain species may be detected by the fœtid odour of sulphuretted hydrogen given off when decaying." I cannot help thinking that this odour is also given off by the living plant.

The Rev. G. R. Bullock-Webster, M.A., remarks of the *Characeæ* that they "are singularly sensitive of any intrusion by other plants, and if they are not allowed to occupy the whole ground generally retire altogether." "As soon as other aquatics begin to assert their existence in the ditch, drain, or pool occupied by Charas they retire, and only appear again when spade and shovel have effected a thorough cleaning out of the old home."

The following Hepaticæ and Mosses have been found at Sutton. These were, with one exception, all identified by Mr. W. H. Burrell.

Hepaticæ.

Ricciocarpus natans, L.
In some abundance in the waters adjoining the Laboratory.

Lunularia cruciata, L.
In a ditch.

Aneura pinguis, L.
Middlemarsh.

Lophocolea bidentata, L.
Middlemarsh.

Of these *Ricciocarpus natans*, L. is the only actually aquatic species.

MOSSES.

Sphagnum squarrosum, Pers. Middle marsh.

,, rubellum, Wils. Middle marsh.

Ceratodon purpureus, Brid. Middle marsh.

Fissidens adiantoides, Hedw. Middle marsh.

Weisia mycrostoma, C. M. Hedge by roadside.

Physcomitrium pyriforme, Brid. Ditch by roadside.

Funaria hygrometrica, Sibth. Middle marsh.

Bryum capillare, L. Middle marsh. Common on hedges, &c.; in meadow near house, &c.

Mnium rostratum, Schrad. Middle marsh.

,, hornum, L. On hedge.

Fontinalis antipyretica, L. Middle marsh. This is not its proper station. It is an aquatic which has probably been thrown out on the marsh where I found a fragment. It most likely abounds in the Broad though I failed to locate it there. W. H. B.

Brachythecum rutabulum, B. & S. Middle marsh; wet meadow near house.

,, velutinum, B. & S. Ditch by roadside.

,, purum, Dixon. Wet meadow near house.

EURHYNCHIUM PRŒLONGUM, B. & S. Wet meadow near house.

,, SWARTZII. Hobk. Rough ground near house.

AMBLYSTEGIUM SERPENS, B. & S. Hedge.

HYPNUM STELLATUM, Schreb. Middle marsh.

,, ADUNCUM Hedw.
,, var. PATERNUM, Sanio } Ditch — These are two large species very abundant in ditch on left hand going towards Wood St., not far from the Laboratory. W. H. B.

,, GIGANTEUM, Schp. Ditch

,, SCORPIOIDES, L. Middle marsh.

,, CUSPIDATUM, L. Middle marsh, and in wet meadow near house.

HYLOCOMIUM SQUARROSUM, B. & S. Wet meadow near house.

DICRANOWEISIA CIRRATA, L. & C. Occurs on thatch at Wood St.

Hypnum cuspidatum, L., is the predominant species (of Moss) in the swamps, and with it are associated *Hypnum scorpioides*, L., and *H. giganteum*, Schp., W. H. B.

It will be noted that there are two species of *Sphagnum*, the true Bog-moss, in the preceding list. Most of the other Mosses mentioned are of common occurrence, but *Fontinalis antipyretica*, L. is of some interest, as a truly aquatic Moss.

The Ferns of the district are chiefly represented by the Marsh-Fern (*Lastrea Thelypteris*, Presl.) which is extremely common, and Osmunda regalis, L., not common now except in places protected from the depredations of fern-hunters. Ophioglossum vulgatum, L., also occurs, as one would expect, and Asplenium Adiantum-nigrum, L., Lastrea Filix-mas, Presl., Polypodium vulgare, L., while Pteris aquilina, L., is found in the drier parts.

The dominant Monocotyledonous orders are Typhaceæ, Naiadaceæ, Hydrocharideæ, Gramineæ, Cyperaceæ, Juncaceæ, Iridaceæ, Lemnaceæ. Sub-dominant are Sparganiaceæ, Alismaceæ, Orchidaceæ. The bulk of the aquatic flora, excepting Characeæ, is included in these families. Presently I shall have something to say as to their grouping in plant-associations.

Going on to the Dicotyledones, we find as dominant

orders Salicaceæ, Myricaceæ, Polygonaceæ, Caryophyllaceæ, Nympheaceæ, Ceratophyllaceæ, Ranunculaceæ, Saxifragaceæ, Rosaceæ, Leguminoseæ, Lythraceæ, Onagraceæ, Halorrhageæ, Umbelliferæ, Primulaceæ, Gentianaceæ, Labiatæ, Scrophulariaceæ, Lentibulariaceæ, Valerianaceæ, and Compositæ.

A. F. W. Schimper has divided the aquatic plants into five types, often more or less connected by intermediate forms.

These five types are :—

1. Isoetes type. Completely submerged rosette-plants, rooted in the ground, usually with cylindrical leaves.

2. Nymphaea-Hippuris type. Plants rooted in the ground, reaching the surface of the water by means of long-stalked leaves or long shoots, and therefore partly in the air.

3. Naias type. Plants rooted in the soil, or free-swimming, with long flowing shoots.

4. Hydrocharis type. Free-swimming plants with short shoots, (*a*) quite submerged, (*b*) greater part submerged, (*c*) half-submerged, (*d*) greater part floating on the surface, (*e*) greater part projecting above water.

5. Podostemon type. Submerged plants fixed to stones in running water.

I am not aware of the existence in the Ant district, of any representative of the first, or Isoetes type, though one of the type, Pilularia globulifera, L., formerly occurred at two or three places in East Norfolk.

The majority of the aquatic plants about Sutton, belong to Schimper's second or Nymphea-Hippuris type. They are "rooted on the ground, reaching the surface of the water by means of long-stalked leaves, or long shoots, and therefore partly in the air." The following are of primary importance, on account of the large area they occupy, and their dominant position with regard to other species.

Phragmites communis, Trin.

Scirpus lacustris, L.

Iris pseudacorus, L.

Cladium jamaicense, Crantz.

Ranunculus Lingua, L.

Castalia speciosa, Salisb.
Nymphea lutea, L.
Potamogeton natans, L.
Hottonia palustris, L.
Hippuris vulgaris, L.
Elodea canadensis, Michx. Many of the dykes are crowded with this.
Myriophyllum spicatum, L.
Scirpus fluitans, L. In dense masses in dykes.
Glyceria fluitans, R. Br.
G. aquatica, Sm.
Alisma Plantago-aquatica, L.
Typha latifolia. L.
T. angustifolia, L.
Equisetum palustre, L.
and less common,
Sagittaria sagittifolia, L.
Sparganium simplex, Huds.
Acorus Calamus, L.
Equisetum limosum, Sm.

There are two or three plants in the preceding list which possess some importance from an economic point of view. The stems of Phragmites are used largely for purposes of thatching.

Mr. Gurney has supplied the following interesting particulars with reference to the use of reeds for thatching purposes, etc. The amount cut in 1905, at Sutton was from 1000–1200 fathoms (a fathom being 5 bunches). The reeds vary in quality, the longest, of which there is only a little grown at Sutton, being used by builders for ceiling purposes. What is known as "short reed" is the best for thatching. There is also "mixed reed and gladden" (reedmace), which, though forming almost as durable a roof as "short reed," does not produce as neat an effect. The reed is cut as soon as the leaf is off, *i.e.*, early in January, and cutting must cease by Lady Day, as the young growth is then beginning to appear.

A well-made roof will, under favourable conditions, last a great number of years, though in some situations, the wind, and bird and animal vermin are apt to play havoc with it.

Under the best circumstances, it is well to have the roof cleaned down every five years or so, as the growth of moss is injurious, and the reeds are liable to get a little loose. The best material for the ridge of the roof is sedge, but it is not much used now, as it is less easily procurable than straw, and the hands of the workers are likely to be cut by the sharp edges of the stems.

The growth of the Reed-beds at Sutton is not so good as it was. The reason may be, that as the beds rise by their own growth they get less water, and in consequence, there is an invasion of the Reed-mace. A little salt from the tides is supposed to be beneficial to the growth of the Reed. Dr. Marshall Ward states Phragmites as an indicator of a sufficiency of potassium salts, in moister soils.

The use of reed-thatched roofs seems to be on the increase for ornamental buildings.

I am not aware if Cladium is utilised specially in the Sutton district, but it was formerly "considered as a valuable natural crop" in the Fenland, and was used for "lighting fires at Cambridge and other places." Bab. Flora Cam., p. 253.

Large quantities of the stems of the Bulrush (*Scirpus lacustris*, L.) are cut yearly, and are used in the manufacture of horse-collars, baskets, and matting. The matting is made of stems plaited in strips about 4 inches in width. The strips are eventually sewn together to form the required size. I was informed at the rush-factory in Norwich, that there is a considerable demand for this matting for laying under carpets, to protect the latter from contact with the bare floor. The baskets made here are very neat and serviceable, but the horse-collars form the principal part of the industry.

In the days of rush-lights, the trade in Bulrushes was carried on in Norwich at a rush-fair, which many of the older inhabitants can remember.

The third, or Naias type consists of "Plants rooted in the soil, or free-swimming with long flowing shoots." The free-swimming forms include

Utricularia vulgaris, L.

U. minor, L.

U. intermedia, Hayne.

Rooted forms include, the Batrachian Ranunculi,

R. CIRCINATUS, Sibth.

R. PELTATUS, Schrank.

R. HEDERACEUS, L.

The Batrachian Ranunculi are, doubtless represented by several more species in the district.

MYRIOPHYLLUM VERTICILLATUM, L.

SPARGANIUM MINIMUM, Fr.

This occurs in some abundance in a dyke near the Laboratory.

POTAMOGETON POLYGONIFOLIUS, Pour.

P. ALPINUS, Balb.

P. LUCENS, L.

P. PRAELONGUS, Wulf.

P. PERFOLIATUS, L.

P. CRISPUS, L.

P. ZOSTERŒFOLIUS, Schum.

P. OBTUSIFOLIUS, M. & K.

P. FRIESII, Rupr.

P. PUSILLUS, L.

CHARACEÆ, see preceding list.

NOTE.—*Najas marina*, L., has only been found in Britain in the Hickling District. It was first discovered in Hickling Broad, by Mr. A. Bennett, in 1883.

The fourth type of aquatic plants is Schimper's Hydrocharis-type, "free-swimming with short shoots."

Quite submerged, there are :—

LEMNA TRISULCA, L.

Greater part submerged :—

STRATIOTES ALOIDES, L.

Greater part floating on the surface .—

HYDROCHARIS MORSUS-RANAE, L.

LEMNA MINOR, L.

RICCIOCARPUS NATANS, L.

Of the fifth, or Podostemon type, consisting of submerged plants fixed to stones in running water, I can say but little. I presume *Fontinalis antipyretica*, L. (a fragment of which was found by Mr. Burrell at Sutton) would represent this type.

Of the Podostemaceæ, in general, Professor S. H. Vines

says, "A very remarkable group of plants, growing on stones, etc., in swiftly flowing streams and rivers of the tropics." It is obvious, the conditions required by this type, do not occur at Sutton.

Some notes made in July, 1905, on Plant-associations amongst the aquatics may be of interest in helping to form a general idea of the aspect of the vegetation. The plants are arranged roughly, in comparative order of abundance.

Sutton Broad, Stalham side.

*Scirpus lacustris, L.

Phragmites communis, Trin.

*Ranunculus Lingua, L.

*Castalia speciosa, Salisb.

*Nymphea lutea, L.

*Utricularia vulgaris, L.

Menyanthes trifoliata, L. Thick under-growth of leaves, flowering being over.

The surface of a dyke at Fenside, Catfield, was almost entirely covered with *Scirpus fluitans*, L. This dyke formed a very interesting sight, as the following plants had grown through the thick mass of *Scirpus* and were flourishing.

Nasturtium officinale, R. Br.

Potentilla palustris, Scop.

Juncus lamprocarpus, Ehrh.

A dyke (Border Dyke) at Sutton was also full of *Scirpus fluitans*, L., in this case associated with

Stratiotes aloides, L.

Sagittaria sagittifolia, L.

Potamogeton natans, L.

Osborne's Dyke along the road-way leading to the Laboratory contained a luxuriant growth of

Alisma Plantago-aquatica, L., with

Glyceria fluitans, R. Br., and

Nasturtium officinale, R. Br.

A dyke on the eastern boundary of Hand Marsh, Sutton, apparently very full of *Elodea Canadensis*, Michx, contained also *Stratiotes*, *Hydrocharis*, *Nymphea lutea*.

* Those marked with an * were in flower.

These plant-associations present some interesting problems. For instance, periodic examinations of particular dykes would show which plant tended to become dominant, and, possibly, to drive out others. Also, does *Stratiotes* rise or sink through *Elodea*, or carry it up and down with it by means of its pointed teeth ?

The salinity of the water of Sutton Broad has been estimated by Mr. F. Balfour Browne at from 7 to 9 grains of chlorine per gallon; but as far as one can gather from the nature of the flora, there is nothing specially to indicate nearness to the sea, except, perhaps, the occurrence of *Samolus valerandi*, L. This plant is generally found in maritime districts, and usually indicates present or former littoral conditions.

For the purpose of comparison, it may be of interest to insert here a few records of plants occurring at about the same period of the year in the Hickling District.

On the banks of Candle Dyke were found

Scirpus maritimus, L.

S. Tabernaemontani, Gmel.

Both of these are maritime plants.

In Heigham Sounds, many square yards of the surface were covered with *Ranunculus circinatus*, Sibth, in flower, in 3–6 feet of water. This produced a striking effect in the distance, as the individual flowers appeared absorbed in one vast white sheet. *Myriophyllum spicatum*, L. was almost as abundant in other portions of the Sounds, the green flowering spikes rising 2–3 inches from the surface of the water. Both plants were associated with *Hippuris vulgaris*, L. in fruit, and *Utricularia vulgaris*, L. in flower. *Phragmites* here was higher than on Hickling or Sutton Broads, and quite impenetrable in places. It had, I presume, not been cut recently. *Typha angustifolia*, L. occurred in considerable quantity. *Œnanthe Phellandrium*, L. was observed, but did not seem to be abundant. *Potamogeton interruptus*, Kit. (=*P. flabellatus*, Bab.) was in flower and covered a large area. The aquatic form of *Polygonum amphibium*, L. was noted, and *Chara vulgaris* L.

The east side of Hickling Broad, starting from the Pleasure Boat Inn, was fringed with a dominant growth of Phragmites, with *Scirpus lacustris*, L., less common, and in the water shallowing to the edge, *Juncus effusus*, L.

Between Old Meadow Dyke and the main channel, on solid marsh, the dominant vegetation consisted of *Cladium jamaicense*, Crantz, with Phragmites. On the west side of the channel, *Typha angustifolia*, L. was in the ascendant. The bottom of the Broad is mostly covered with a dense mass of *Chara aspera*, Willd.

At the north end of Hickling Broad, proximity to the sea was indicated by the occurrence of *Apium graveolens*, L.

Mr. Clement Reid, F.G.S., alluding to the land around Happisburgh and Bacton, remarks that "its exposure to the north-east winds makes the crops late." My own observations have not extended over a sufficiently long period to enable me to state whether these cold winds have the effect of retarding the appearance of flowers in the Sutton district, though it would seem probable that they would have this effect. Miss A. M. Geldart suggests that the retardation of the crops may be due rather to the salinity of the north-east winds than to their coldness.

At Longmoor Point, on 23rd and 24th April, 1905, with the exception of *Caltha palustris*, L., and *Carex Goodenowii*, J. Gay, both of which were blooming freely, very few flowers were to be seen. Flowers of *Cardamine pratensis*, L. were few and far between. *Salix repens*, L. was flowering and beginning to leaf, and the young shoots of Phragmites rose from 3–6 inches above the water. Those flowers which were in bloom on the dates just mentioned were at about their normal time. Mr. A. W. Preston's observations of first flowering of common plants for 10 years from 1888–1897 give average dates for *Caltha palustris*, L., March 30, and *Cardamine pratensis*, L., April 26, at Brundall and Blofield. On April 5th, 1903, which was exceptionally early, I observed *Cardamine pratensis*, L. in flower at Reedham. Further observations of first flowering of some of the common plants at Sutton, might be of interest in showing to what extent, if

any, there was a retardation of flowering, owing to the cold winds, or other meteorological influences.

The winter aspect of the region is a startling contrast to the summer one, though possessing much interest, even from an aesthetic point of view. On 10th Dec., 1905, several flowers of *Ranunculus Flammula*, L. were found, though the dykes had a thin coating of ice on their surfaces, through which the bright green submerged leaves of *Hottonia palustris*, L. could be seen. Stratiotes, of course, had sunk to the bottom, but many plants looked green and healthy, and *Sparganium minimum*, Fr. appeared almost as fresh as in the summer.

Let us turn now to the Flora of the marshes proper. Though there is a continual formation of a coarse kind of peat going on in our marshes, it is very unlike the peat which is characteristic of the moors of Yorkshire and Derbyshire, which is mainly composed of Sphagnum.

From Sendtner's experiments, quoted by Schimper, it appears that calcium acts as a poison on Sphagnum.* It does not seem clear from the context, whether by calcium is meant calcium carbonate, or the metal calcium, as free calcium is not known to occur in nature. If the calcium carbonate acts as a poison on Sphagnum, it is strange that such large patches of this Moss should occur at Sutton, impregnated as the soil and waters are with this salt.

An estimate of the rate of growth of the peat in Norfolk was made by the late John Gunn in his 'Geology of Norfolk.' I cannot do better than quote his words. "The formation of turbaries is very interesting and important for the determination of the age of the remains embedded in them and the remains frequently reflect light upon the age of the turbary. The discovery of several coins in Catfield, the latest of which was of the reign of Edward VI., proves that there was water when the coins were sunk, and the peat has grown up since, and become a solid turf-ground. It is formed by the annual growth and decay of several marsh plants, as *Typha latifolia* and *T. angustifolia*, *Scirpus lacustris*, *Cladium*

* 'Plant Geography,' p. 95.

mariscus, etc., and is estimated at the rapid growth of a foot in twenty years."

It will be of interest to compare this estimate of the rate of growth of the peat, with that obtained by the late Rev. L. Jenyns (quoted by the late Professor Babington) as to the rate of its growth in the Fenland, at Isleham. He gave it as the turf-cutters' opinion that " before the present more perfect drainage of the Fen (Isleham) the turf grew at the rate of about twenty inches in sixteen years." This is a little more than double the rate just given for Catfield. Allowing for difference of drainage, it seems probable that the late Mr. Gunn's estimate was not very far wrong.

Schimper divides moors into two classes, viz., high-moor and meadow-moor, the former being poor in lime, the latter rich in lime. Accepting this division, our marshes would come under his description of meadow-moor. He goes on to say, " the humates are less plentiful in the water from meadow-moors because their humus acids form insoluble compounds with lime."

The subject of the formation of humic acids, and of the peat is one of great interest, and presents many, apparently as yet, unsolved problems. The term "humic acid" is frequently used in discussions on soils, etc., but it seems a very vague one. As far as I can gather, it has no strict definition, and there is certainly no formula for it. However, I am informed, on good authority, that there are no acid waters in Norfolk, owing to the large quantity of alkalis present. The above remarks may seem somewhat of a digression, but the subject has important bearings on the Flora, which I hope will be worked out, in the future.

Amongst the chief constituents of the marsh flora, as distinct from the aquatic, are the following :—

Caltha palustris, L.
Lychnis Flos-cuculi, L.
Lotus uliginosus, Schkuhr.
Spiræa Ulmaria, L.
Potentilla palustris, Scop.
Parnassia palustris, L.

Lythrum Salicaria, L.
Epilobium hirsutum, L.
E. palustre, L.
Hydrocotyle vulgaris, L.
Cicuta virosa, L.
Œnanthe fistulosa, L.
Angelica sylvestris, L.
Peucedanum palustre, Mœnch.
Valeriana officinalis, L.
V. dioica, L.
Cnicus palustris, Willd.
C. pratensis, Willd.
Lysimachia vulgaris, L.
Pedicularis palustris, L.
Rhinanthus Crista-galli, L.
Myrica Gale, L.
Salix (sp.)
Epipactis palustris, Crantz.
Orchis latifolia, L.
Juncus effusus, L.
J. conglomeratus, L.
J. supinus, Mœnch.
J. lamprocarpus, Ehrh.
J. acutiflorus, Ehrh.
Luzula erecta, Desv.
Alisma ranunculoides, L., and var. repens, Dav.
Scirpus Caricis, Retz.
Eriophorum angustifolium, Roth.
Schœnus nigricans, L.
Carex (see separate list).
Phalaris arundinacea, L.
Anthoxanthum odoratum, L.
A generally distributed grass.
Phleum pratense, L.
Agrostis palustris, Hnds., var. stolonifera, L.
Deschampsia caespitosa, Beauv.
Holcus lanatus, L.
Cynosurus cristatus, L.
A generally distributed grass.

Some of the plants in the above list are worthy of special consideration with regard to their distribution. *Potentilla palustris*, Scop., occurs in great abundance, covering the surface of the marsh in many places with a thick growth of leaves. Less conspicuous, though very common is *Hydrocotyle vulgaris*, L. *Angelica sylvestris*, L. and *Peucedanum palustre*, Mœnch, are typical *Umbelliferæ* of this district, and possess special interest as being the food-plants of the caterpillar of the Swallow-tailed Butterfly (*Papilio machaon*, L.). Mr. A. Bennett says with regard to *Peucedanum palustre*, that Norfolk is the headquarters of this species in England. It is one of the rarer plants of Britain now, owing, probably, to the increased drainage operations in its special habitats. I am happy to say, it is still abundant in the Broads district. *Cnicus pratensis*, Willd., adds largely to the beauty of the marshes during its season of flowering in the latter half of June. Also, *Eriophorum angustifolium*, Roth.

One of the grasses calls for special mention, viz., *Deschampsia cæspitosa*, Beauv. (*Aira cæspitosa*, L.). Two or three large tussocks of this grass occur in a damp meadow not far from the Laboratory. Its occurrence is generally indicative of a "sour" soil, especially if associated with sedges and rushes.*

The genus *Carex* forms such an important part of the marsh-flora, and is so characteristic of marshes generally, it seemed to me that a separate preliminary list of those species found in the Sutton district would be of interest as forming a basis for future botanising. No doubt, this list could be considerably extended by further search.

Preliminary List of Species of Carex in Sutton District.

Carex pulicaris, L.
C. disticha, Huds.
C. teretiuscula, Good.

* See 'Grasses,' H. Marshall Ward, Sc.D., F.R.S., p. 33.

Carex paradoxa, Willd. For records of this rare species see Norf. and N. Nat. Trans. vol. vii. p. 695.
C. paniculata, L. Forms dense tussocks.
C. vulpina, L. Forms dense tussocks.
C. curta, Good. Rather rare generally. "Known in 4 stations in county." Messrs. Bennett and Salmon, 1903.
C. Hudsonii, Ar. Benn.
C. Goodenowii, J. Gay
C. panicea, L.
C. flava, L.
C. filiformis, L.
C. Pseudo-Cyperus, L. Not common. Generally growing in the water.
C. rostrata, Stokes. The most common marsh sp.
C. riparia, Curtis.

The following are characteristic plants, though not in great abundance.

Neckeria claviculata, N. E. Br.
Cardamine amara. L.
Viola palustris, L.
Polygala vulgaris, L.
Stellaria palustris, Retz.
Montia fontana, L.
Hypericum elodes, L.
Linum catharticum, L.
Ribes nigrum, L.
Drosera rotundifolia, L.
Sium latifolium, L.
S. erectum, Huds.
Galium palustre, L.
Sonchus arvensis, L.
Pyrola rotundifolia, L
Anagallis tenella, L.
Samolus Valerandi, L.
Myosotis palustris, Relh.
Veronica Beccabunga, L.
Scutellaria galericulata, L.

Liparis Loeselii, Rich.

"Occurs at Sutton associated with *Hypnum cuspidatum*, L., *H. scorpiodes*, L. and *H. giganteum*, Schp." Mr. W. H. Burrell. It has been usually recorded as accompanying *Sphagnum*.

Listera ovata, R. Br.

Orchis maculata, L.

Scilla festalis, Salisb.

Juncus bufonius, L.

Butomus umbellatus, L.

The following xerophilous species occur, probably with others.

Hypericum pulchrum, L.

Ulex europaeus, L.

Potentilla silvestris, Neck.

Chrysanthemum Leucanthemum, L.

Filago minima, Fr.

Leontodon hispidus, L.

Calluna Erica, D. C.

Erica Tetralix, L.

Erythræa Centaurium, Pers.

Teucrium Scorodonia, L.

Briza media, L.

This grass indicates chalk in the soil.*

The occurrence of these xerophilous species amongst the marsh-flora is a fact of some interest. Schimper's view is that many xerophytic types can exist surrounded by excessive moisture in peaty soils, as the humic acids in the soil prevent the plants from absorbing more moisture than they require, that they are, in fact, living in a condition of "physiological drought."

If the opinion I have already alluded to that there are no peaty acids in the marsh soil of Norfolk is correct, it is difficult to account for these types flourishing as they do, under conditions apparently foreign to their requirements, almost side by side with the characteristically marsh species. In

* 'Grasses.' Marshall Ward, p. 32.

the absence of further information on the constitution of the soils and adjacent water, it would be rash to hazard a theory to account for this apparent contradiction. A closer examination of the position of these xerophytes may show, that, though they appear to be associated with a more or less hygrophytic flora, they may, in fact be confined to islands, as it were, or patches of a more gravelly or sandy nature, scattered here and there about the marshes.

"The term Xerophytes includes three groups of plants, salt-loving plants or Halophytes, plants living in dry well-drained soil, and plants living in badly-drained soil, where evaporation being rapid upon the surface so cools the underlying soil or water that absorption is very slow."*

It may be that in the last part of the preceding sentence lies the explanation of the occurrence of these Xerophytes in our marsh-flora, amongst the ordinary marsh species.

With a view to forming an idea of the comparative abundance and absolute number of species growing in a typical portion of the marsh, a square yard was marked off in the Middle marsh at Sutton, and a rough census taken of its vegetable inhabitants, with the following results :—

26	plants of	Menyanthes trifoliata.
24	,,	Juncus effusus.
20	fronds of	Lastrea Thelypteris.
12	plants of	Spirea Ulmaria.
9	,,	Rhinanthus Crista-Galli.
7	,,	Arundo Phragmites.
5	,,	Peucedanum palustre, small.
3	,,	Salix (sp.).
2	,,	Epipactis palustris.
1	,,	Anagallis tenella.
1	,,	Œnanthe fistulosa.

Also, *Hydrocotyle vulgaris* in quantity, with *Equisetums* and various seedlings, forming a rather thick undergrowth.

The above figures can, of course, only be taken as an

* See 'Flora of Cambridge District,' A. Wallis, B.A., in Handbook to Natural History of Cambridgeshire, p. 214.

approximation, as the operation of counting plants under such conditions is more difficult than one would be led to suppose. We may compare this with a census made by Mr. Wallis,* of a square yard of rather bare chalky soil in the Cambridge District, which was as follows :—

125 Plants of Festuca ovina.
40 Leontodon hispidus.
8 Hieracium Pilosella.
3 Gentiana campestris.
2 Polygala calcarea.
2 Avena pratensis, seedlings.

It will be noted that though there appears to be a greater number of plants in the latter locality, all of a distinctly xerophytic type, the number of species is less than half that of the square yard of marsh. The comparison seems to show the more monotonous character of a strictly xerophytic flora. The square yard of marsh examined formed part of a bog which was evidently submerged, during some months of the year, under an inch or two of water. In the same marsh, but outside the square yard examined, were plants of

Epipactis palustris, Crantz.
Orchis latifolia, L.
Myrica Gale, L.
Salix repens, L.
Schœnus nigricans, L.
Cladium jamaicense, Crantz.

The surface of the marsh was broken here and there by dense clumps of Salix and Myrica Gale. These clumps afforded shelter to bright masses of *Spiræa Ulmaria*, L., *Lysimachia vulgaris*, L., *Lythrum Salicaria*, L. and the more sombre-coloured *Valeriana officinalis*, L.

A more varied flora was exhibited in a marsh meadow on the Sutton village side of the Laboratory. I venture to use the term marsh-meadow to signify an intermediate position between actual marsh and meadow. Though rather wet in

* See 'Flora of Cambridge District,' A. Wallis, B.A., p. 224.

places, and containing the usual marsh plants, yet one was surprised to find many plants associated with them more suggestive of an ordinary meadow, such as

Ranunculus acris, L.
Trifolium pratensis, L.
T. repens, L.
Lathyrus pratensis, L.
Vicia Cracca, L.

Here *Listera ovata*, R. Br. was growing in hundreds not far from

Genista anglica, L., and
Erythræa Centaurium, Pers.

The importance of statistics in the study of biology, has been recognised for some years, mainly through the work of Prof. Karl Pearson, Mr. F. Galton, and others. The use of statistical methods now forms one of the main avenues for approaching the solution of biological problems. I am not aware that much work of this nature has been done from the side of bionomical botany, but there is no doubt a promising field open for future workers in this direction. Statistics of the plants in very many square yards in different positions of the area examined and at different periods, would be of great value in supplying thoroughly reliable data with regard to the increase or decrease of certain species.

It is not necessary here to dilate further upon the valuable results which would follow from careful statistical investigations in field-botany, as it is evident, that by their means many obscure points might be elucidated.

On the whole, the Flora we are now considering may be said to be very similar to that of the Fenland of Western Norfolk and Cambridgeshire. Professor Babington's list of the plants of Wicken Fen (Flora of Cambridgeshire, 1860), corresponds very closely with a list of those found in the Sutton district quite recently. **Cladium jamaicense*, Crantz, however, still, as formerly, seems to occupy a more dominant position in the herbage of the Fenland, than in our Broadland.

* Mr. Wallis.

Five Fenland plants are quoted by the late Mr. W. Marshall as now probably extinct in the Fens. They are

Senecio paludosus, L.
S. palustris, D. C.
Sonchus palustris, L.
Malaxis paludosa, Sw.
*Liparis Loeselii, Rich.

Of the above plants, it is somewhat doubtful if *Senecio paludosus*, L., has ever been found in East Norfolk. *Senecio palustris*, D. C. is recorded in Trimmer's Suppt. to Flora of Norfolk, as occurring at Stalham in 1875, but it is evidently very rare now. *Sonchus palustris*, L. has not been recorded from the Sutton district, and is probably almost extinct in East Norfolk. The same may be said of *Malaxis paludosa*, but *Liparis Loeselii*, Rich, is still to be found with us.

Teucrium Scordium, L., formerly a common Fenland plant, though now disappearing, has only been recorded once for East Norfolk, at Horning, many years ago. Similarly, *Ranunculus Lingua*, L. which is a very common plant in the Ant district, is stated by the late Mr. W. Marshall as "once common, now rare," in the Fenland. Under the same heading, Mr. Marshall includes the following species.

Castalia speciosa, Salisb.
Nymphea lutea, L.
Carduus palustris, L.
Utricularia vulgaris, L.
Alisma ranunculoides, L.
Scirpus fluitans, L.
Carex rostrata, Stokes (C. ampullacea, Good).

All these plants may be described as very common in the Sutton district. It is probable, that the late Mr. Marshall, in calling these plants "once common, now rare," was thinking of the much more restricted area, in which, owing to increased drainage, it was possible for them to find a habitat in the Fenland.

* 'Fenland,' p. 304.

Allowing for a few exceptions, it seems that at least in the higher phanerogamic plants, the floras of the Fenland and the Ant district are nearly identical.

The principal bog-moss of the Fenland is "a strong-growing form of *Hypnum fluitans*," Sphagnum being "quite rare." 'Fenland,' p. 555.

In drawing my preliminary survey to a close, I can only hope that I have succeeded in conveying, if only imperfectly, a general idea of the botany of this region. It may not be superfluous to remark that the main object of a botanical survey of any district is not attained by compiling a list of plants found, only. Rare plants are, of course, of great interest, but the commonest ones are of greater importance, as from their abundance they may be presumed to be more in harmony with their environment, and thus more truly representative of the district than the rare ones.

I do not mean to infer that a list of plants is to be despised; but something more than that is required in order to describe thoroughly the botanical aspect of an area. A list containing notes and observations on conditions, habitat, etc., is one step in the right direction. But the ideal to be aimed at is the preparation of a map exhibiting the vegetation of the area, as minutely as is possible, with a separate description of all the conditions under which plants grow, such as the plant-associations, chemical nature of soils and waters, meteorological phenomena, action of insects and animals, etc. In short, the help of all branches of natural science is required to thoroughly elucidate the plant-phenomena of even a comparatively small area.

The importance of photography to botany has already been recognised by the British Association.

NOTE.—(During the reading of this paper some lantern slides of photographs prepared by Mr. F. Balfour Browne, illustrating some of the typical plants of the district, were shown on the screen by Mr. H. Brittain. These included Menyanthus, Alisma plantago, Water Ranunculus, Hottonia, Hippuris, and Eriophorum.)

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X.

A STUDY OF THE AQUATIC *COLEOPTERA* AND THEIR SURROUNDINGS IN THE NORFOLK BROADS DISTRICT.

(Second Paper.)

By Frank Balfour Browne, M.A. (Oxon.), F.R.S.E., F.Z.S.,
Director of the Sutton Broad Laboratory.

Read 27th February, 1906.

In my previous paper upon the Aquatic *Coleoptera* and their surroundings in the Norfolk Broads District, I referred to some of the facts which I had observed during the season 1904 as to the occurrence, distribution and habits of this interesting group. I worked out the number of species per collection per month, and drew curves giving a graphic representation of the results, and from the curves thus obtained as well as from the fact that crowded centres of various species occurred especially in spring and autumn I suggested that there were probably two seasons of the year in which imagos hatch out from the pupal condition, that at least many of the species have two broods in the year, and I considered that the crowded centres were centres of distribution of the various species.

With another season's experience in the collection of these interesting water insects, I come here with the intention of correcting and modifying some of the explanations of facts which I gave last year. The necessity for correction depends partly upon the fact that I have discovered that a method upon which I based my record of species per collection per month, in mapping out the curves for my last paper, is quite unsuited to the purpose under the circumstances.

Reference to my last paper will show that I mapped out two curves, one showing the number of species per collection per month, of the *Hydradephaga* or carnivorous Water Beetles, the other showing the same of the *Palpicornia* or herbivorous Water Beetles. It was not until I had worked out upon the same method the results for 1905 that an error in the method occurred to me, and it was owing to the fact that the curve obtained for 1905 did not agree with certain observations I had made, that I was induced to go more carefully into the question of the principle upon which the curve had been obtained.

August, 1905, was a particularly dry month so far as the marshes were concerned, although in rainfall it was actually wetter than the same month in 1904. I will go into this point later on, but for the moment I need merely state that the marshes were so parched last August that I only made 37 collections instead of the 100 or so which I had counted upon making. I had been paying attention to the question as to what happens to the denizens of a pond or dyke when the water has all evaporated, and I had worked out from my records the fact that the collecting places where the 37 collections were made in August were not as a whole richer either in species or in individuals than the same collecting places had been in June. I was, therefore, surprised after working out upon the 1904 method the number of species per collection per month, to find that August was much richer than any other month during the season. Had I been a mathematician no doubt the reason would have been obvious from the first: but as it was it took some time before I understood it. The error in the method lies in the fact that I had not been considering equal numbers of collections in each month, and that, under ordinary circumstances, the tendency would be for a month in which fewer collections had been made to show a higher number of species per collection than a month in which more collections had been made. Suppose for instance, we have 99 collections, each containing 9 species, and we then make one more collection and find 10 species. This additional species raises the average for the total number of collections

from 9 to 9.02 species per collection. If, on the other hand, we have only 9 collections containing 9 species and make one more collection and find 10 species, the average is raised by the additional species from 9 to 9.1, giving thus a difference of .08 in the two results. If, on the other hand, instead of only finding 10 species in the final collections we had found 20, the average would have been raised in the first case to 9.11 and in the second to 10.1, a very considerable difference.

I therefore made enquiries as to whether the law of probabilities could so adjust such differences as to give me results of equivalent value for the varying number of collections; but beyond learning that some application of the calculus would lessen the discrepancies, I have not heard of any principle in mathematics which could assist me. I have, therefore, had to adopt an entirely different method since the number of collections per month varies so greatly and this method consists in taking a pair of months and including only the collections made at collecting places visited in both months, that is, leaving out of consideration all the collections made in one month if the same collecting places were not re-visited in the other month. Thus, for instance, I visit collecting places A, B, C, D, E, in March, and in April I only visit A, C, and E. Collections made at B and D will, therefore, have to be left out in working out my results. By this method I can compare March with April and see whether the number of species has on the average increased in April at the collecting places which were visited in March; similarly I can compare April with May, May with June, and so on, and I can from these results draw a curve showing the increase or decrease in species per collection from March to April. April to May, May to June, and so on. The result of such a comparison is shown in the dotted curves in Chart I.

Now it is obvious that in this method I may be using exactly the same collecting places in comparing March with April as I use in comparing April with May, in which case, of course, the increase or decrease from April to May will, when combined with the increase or decrease from March to April, give the true relationship between March and May. As a fact, how-

ever, many of the collections made in April which were used in comparing March and April will not be used in comparing April and May and vice versâ, so that the resulting curve

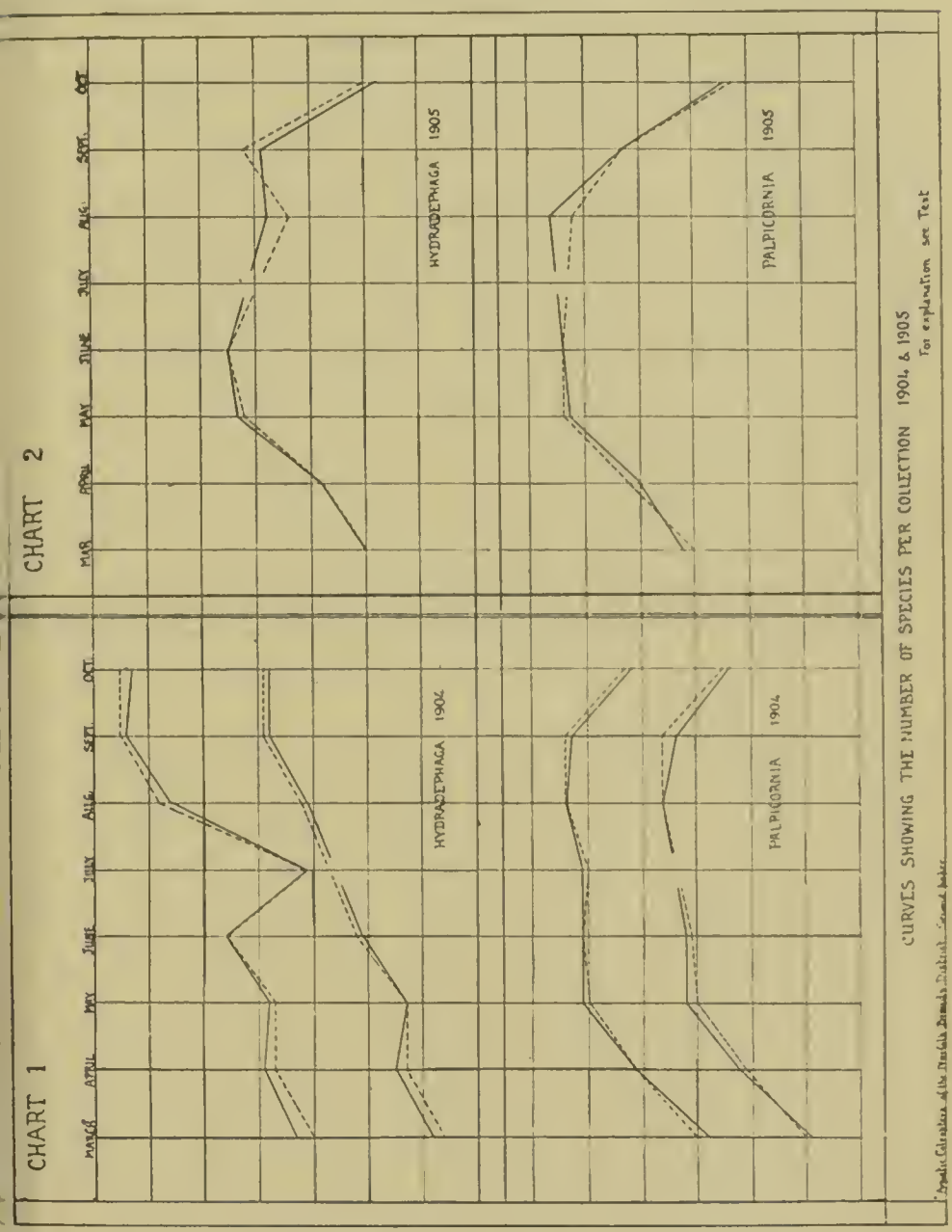


CHART 2
HYDRADEPHAGA 1905
PALPICORNIA 1905
MAR. APRIL MAY JUNE JULY AUG. SEPT. OCT.
CHART 1
HYDRADEPHAGA 1904
PALPICORNIA 1904
MARCH APRIL MAY JUNE JULY AUG. SEPT. OCT.
CURVES SHOWING THE NUMBER OF SPECIES PER COLLECTION 1904 & 1905
For explanation see Text

does not show anything more than the relationship between one month and the months immediately preceding and following it. That is. the curve shows no true comparison

of March with May, June, and so on. It was, therefore, necessary to compare each month with every other month, and then to take the means of the results thus obtained and the result is shown in the plain line curves in Chart 1, which do not quite agree with the dotted curves.

I have thus obtained a new set of curves for 1904, which must supersede the curves shown in table 1, p. 64, of my previous paper.

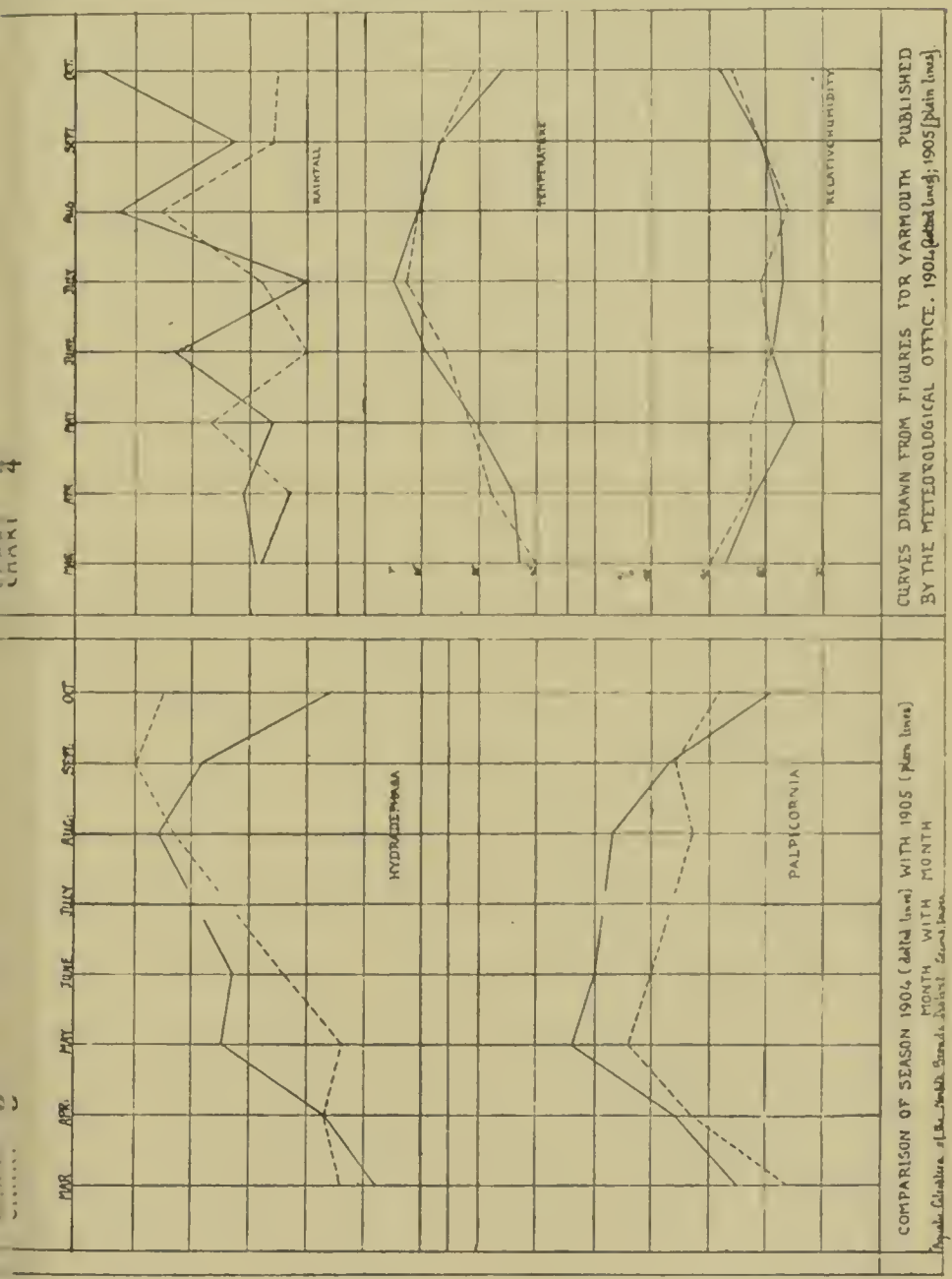
During the past season I have worked over the same collecting area as in 1904, visiting for the most part the same collecting stations regularly from March to October, except in July, when I was away in Scotland. During the 7 months I have made 715 collections, the number being smaller than it would have been had not August been such a bad month as already mentioned.

On the method referred to I have worked out the curves of species per collection of the *Hydradephaga* and *Palpicornia* for 1905, and they are shown in Chart 2, side by side with the new 1904 curves. I have also inserted in the 1904 chart a curve the result of working out the collections omitting July, in order to be able to make a fair comparison between the seasons 1904 and 1905.

Now there are, of course, no data in the curves for 1904 and 5 which admit of their being compared for relative abundance; that is, there is nothing to show whether the June maximum of 1905 is greater or less than the September maximum of 1904. In order therefore to trace the relative numbers of species per collection during the two seasons, I have compared similar months in the two years—on the principle already referred to, using only collections common to each pair of months—and from such a comparison we can tell whether in March, 1904, individuals were more or less widely distributed than in March, 1905, and similarly for other months, and the results are set out in Chart 3.

From this chart it will be seen that except in March, September and October, the 1905 collections were richer in *Hydradephaga* than the 1904 collections, and that in *Palpicornia* were richer during the whole season with the

exception of October. In other words, with the exceptions mentioned, there was a greater distribution of individuals during last season than during 1904.



If we now turn to Charts 1 and 2 we shall see at a glance that as far as the *Hydradephaga* are concerned the curves for

1904 and 5 are very different, while those of the *Palpicornia* are more or less similar. In the case of the *Hydradephaga* in 1904, the species per collection, that is the distribution of individuals, gradually increased throughout the year, attaining its maximum in September, while in 1905 the maximum was attained in June, while there was a second but lower maximum in September. I have, of course, compared the second 1904 curve—with July omitted—with the 1905 curve. In the 1905 curve the difference between September and October is very marked, while in the 1904 curve there is no difference at all. In the case of the *Palpicornia* curve the difference between the two years is merely one of degree. The falling off in September and October, 1904, is small, whereas in 1905 it is large. From May to August in both years, is the season " par excellence " for these Beetles, the maximum of species per collection and distribution of individuals being attained in each case in the latter month.

The conditions, therefore, which injuriously affected the *Hydradephaga* in 1905 and so caused a difference from 1904 in the process of distribution, did not so affect the *Palpicornia*, if we except the months of September and October. The *Hydradephaga* and *Palpicornia* curves agree in the decided falling off in species per collection in October, 1905. In September, 1905, it may be also said that they agree, since in the case of the *Hydradephaga*, what was a decided rise in the curve from August to September, 1904, is reduced to a very small rise, and in the case of the *Palpicornia*, what was a small falling off from August to September, 1904, is increased to a decided falling off.

In these respects, therefore, I am inclined to attribute the differences between the 1904 and 5 curves to some conditions which similarly affected both the groups of Water-beetles; but beyond this the curves will not bear comparison.

Before, however, considering what these conditions may have been, it is necessary to re-consider the life histories of the two groups in the light of my last season's experience.

I have already pointed out that when I suggested in my previous paper that the *Hydradephaga* were to some noticeable

extent double-brooded, I drew my conclusions from two sources, one the shape of the curve of the species per collection, and the other, the crowded centres which I had only observed in the spring and autumn, and which I considered to be hatching centres and thus centres of distribution of the particular species. That some of these crowded centres are indeed hatching centres for the imagos, I have since been able to prove, as I shall show directly, and it is, I still think, probable that they all are; but I do not now think that the discovery of such a centre is evidence that a hatch of imagos of the particular species has taken place immediately previous to the discovery. For instance, in September and October, 1904, there were two crowded centres of *Hydroporus granularis*, L., in two dykes in Catfield Fen, and in these same two places the same species was abundant in March, 1905, whereas in April its numbers were not abnormal. *Hydroporus incognitus*, Sharp, swarmed in a certain ditch in Potter Heigham in the Autumn of 1904, and was again abundant in the same ditch all through the spring of 1905, gradually getting scarcer after April and having entirely disappeared by October. I have noticed a few other similar cases and they certainly suggest that it is not safe to rely upon the date of discovery of a crowded centre as indicating the time of the hatch of imagos, unless we have some evidence that the particular collecting place had not been crowded previously.

Now if there are two seasons in the year at which the imagos of various species appear, we should find some evidence of this (1) in the egg-laying period, (2) in the records of well-grown larvæ, and (3) in the observations of the times when soft or recently emerged imagos are to be found.

I have not been able to collect much evidence upon any of these points, but such as I have collected does not seem to bear out the suggestion of there being two cycles in the year. Almost the only evidence I have obtained as to the breeding period of the Water-beetle was got by watching *Helochares lividus*, Forst., and *punctatus*, Sharp. These species carry their eggs about with them attached in a mass to the hind femora. The eggs are apparently thus carried until the larvæ

crawl out of them as I have constantly found the larvæ hatched in a tube containing a few egg-bearing imagos. It is easy, therefore, to observe the "spawning" period of this genus. The first record of eggs last year was made on May 8th, but they were not common until towards the end of the month. There was no record of eggs in August of last year, but in 1904 there were three records for this month, the last being on the 27th. The egg period, therefore, apparently lasts from May to August, the period, according to the curve, when the *Palpicornia* are most distributed. The egg-cocoons of *Hydrophilus piceus*, L. are to be found sparingly in the dykes in this district in June, and one specimen in captivity laid its eggs in that month. *Hydrobius oblongus*, Herbst., also produced its ribbon-shaped egg-cocoon in an aquarium in June, 1905.* I have only one record for the *Hydradephaga*; I found a female of *Dytiscus marginalis*, L., depositing her eggs in April, the usual egg-laying period of this species being given in books as March and April.

My observations as to larvæ have also been very few but they should perhaps be included. The earliest well-grown larvæ of which I have a note, are those of one or more species of *Agabus*, which in 1904 were observed in March and April, and in 1905 as "nearly full-grown" in April and May. I first observed *Dytiscus* larvæ in April, well grown specimens of, I believe, *D. circumflexus*, F., from the fact that where they occurred, I have only taken that species.

I have no records of any other well grown larvæ until June, when *Pelobius*, *Hyphydrus*, *Dytiscus*, *Acilius*, *Gyrinus*, and *Hydrophilus* all occurred. In August again I found *Hyphydrus* common, a few *Pelobius*, and one or two full grown *Hydrophilus*. After that month no full grown larvæ are recorded, but numbers of small larvæ were found in September. At one place, among Chara I found a number of very small *Haliplid* larvæ, which I believe had only hatched a short time previously. In October I recorded half grown *Agabus* larvæ in one pond.

With regard to immature specimens of imagos my records

* The egg cocoons of Hydrobius fuscipes, L., and picicrus, Thoms., have occurred this year, 1906, sparingly in March and commonly in April.

although few are, I think, interesting. Whenever I came across a crowded centre, that is, a place where any species was abundant, I carefully examined a number of the individuals for the purpose of seeing whether they were mature, or soft and recently emerged. In March, April and May every such centre examined was composed of mature individuals, and it is worthy of notice that more such centres were observed in March than in April, and very few were discovered in May. I do not know how long after hatching from the pupa an imago remains sufficiently soft to be recognised as immature, but I should imagine that it would not be more than a few weeks at the most, possibly indeed only a few days, so that it is quite possible that if a "hatching" occurred in a dyke or pond shortly after my month's visit had been paid, I would find a centre of mature individuals on my next return there. It seems, however, significant that whereas at least many of these centres found in the autumn of 1904 remained crowded in the early spring of 1905, the crowded condition did not persist, but usually cleared in April or May. This state of things was not invariable, as one or two crowded centres observed in September, 1904, were not crowded in October, *e.g.*, one of *Hydræna testacea*, Curt., referred to in my previous paper, where the species had entirely disappeared from a dyke in October, after being abundant in September, and where it did not occur again until August, 1905. On the other hand, although as a rule what were crowded centres in the autumn of 1904, cleared in the spring of 1905, there were one or two cases where the clearing up process was very slow, occupying most of the season. Although I have very little evidence at present, it appears to me that when the clearing up process is very slow the species ultimately disappears completely from the dyke or pond, a phenomenon which, if true, is very interesting.

One or two interesting cases occurred in 1905 where I actually found the specimens soft and watched the progress of the centre. On June 3rd I visited a certain ditch in Potter Heigham which was then merely damp, there being no visible water, although on May 10th, the occasion of my previous

visit, there had been enough water to make a collection which was rich in species and individuals. I re-visited the same ditch 9 days later after there had been some rain and made a collection there. I found 13 species of *Hydradephaga*, and 5 species of *Palpicornia*, and the two dominant species were *Ilybius ater*, De G. and *obscurus*, Marsh. I counted 14 specimens of the former and 17 of the latter, and there were more individuals of both species. All the 14 *Ilybius ater* and 16 out of the 17 *I. obscurus* were soft specimens quite recently emerged from the pupal condition. During the same month I found, in two adjacent ponds in the Palling Brick Pits, crowded centres of *Ilybius fuliginosus*, F., the majority of specimens in both cases being soft, some even being brownish, and not yet fully pigmented.

I noticed, however, fewer crowded centres in the autumn last season, than in 1904, and my records for soft specimens mostly refer to one or a few individuals only. All immature specimens observed occurred in June (July, 1904), August, and September with the exception of one record in the latter part of May. In the subjoined table I have included all the cases observed :—

May.	June.	[July, 1904.]	August.	September.
Agabus bipustulatus, L. Common in one or two dykes.	Hydroporus gyllenhalii, Schiödte	Hydroporus gyllenhalii, Schiödte.	Pelobius tardus, Herbst.	Noterus clavicornis, De G. (one sp. only).
	Hydroporus pubescens, Gyll.	Anacæna globulus, Payk.	Hydroporus incognitus, Sharp.	Agabus bipustulatus, L.
	Agabus bipustulatus, L	Anacæna limbata, F.	Copelatus agilis, F.	Agabus nebulosus, Forst.
	Agabus nebulosus, Forst.		Rhantus grapii, Gyll.	Rhantus exoletus, Forst
	Agabus chalconotus, Panz.		Rhantus exoletus, Forst.	Dytiscus marginalis, L.
	Ilybius fuliginosus, F.			Hydrophilus piceus, L.
	Ilybius ater, De G.			Helochares punctatus, Sharp.
	Ilybius obscurus, Marsh.			

It will be noticed that with the exception of *Agabus nebulosus* and *A. bipustulatus* there is no break in the record of species.

With regard to the former species, I think it probably should have occurred immature in August, and with regard to the three or four specimens of the latter producing the record in September, I was very uncertain at the time of finding as to whether they were really soft or not. Leaving out, however, these two possible exceptions the records suggest one hatching period only, lasting perhaps many weeks, but still one period. I am, therefore, now inclined to think that all the evidence with regard to egg-laying, larvæ and immature imagos, although scanty, points to one cycle only in the year and not two, as I previously suggested.

If this idea is correct we have still to account for the double hump curve of the *Hydradephaga* distribution which was so conveniently accounted for on the hypothesis of two hatching periods. I do not doubt that had I collected in the district in July of last season, I should have found a similar falling off in distribution to that which was so marked in 1904: but even without this evidence, the 1905 curve is truly double humped, the two maxima being in June and September just as they were in the complete curve for 1904.

I have already mentioned that I was interested in the question as to what happens to the Water-beetles when their home pond or dyke dries up, and as this may have some bearing upon the nature of the distribution curve, I will recount my observations. In the first place the majority, if not all, the Water-beetles have efficient wings, and some species, especially of the genera *Ochthebius* and *Anacæna*, readily take to flight on a bright hot day when they find themselves stranded upon the collecting sheet. *Agabus bipustulatus*, L., is occasionally to be seen flying about on hot days, and also in such weather is liable to use its wings when dropped upon the dry, hot ground. The natural conclusion to draw from their possession of usable wings is that, as soon as the home-pond or dyke dries up, the individuals will betake themselves to some other patch of water. There are, however, two facts which tend to show that the Beetles do not do this; one is that in the driest season

of the year, the ponds and ditches still containing water are not richer in species or in individuals—they are in fact poorer ; the other is that within a few hours of a dried up pond being re-filled with water, Beetles appear in it.

I had noticed in 1904, that ponds dry one week were certain to contain Water-beetles the following week if, in the meantime, there had been sufficient rain to produce even a thin layer of water on the bottom ; but it was not until last season that I endeavoured to discover where these Beetles came from, and my opportunity was especially favourable during my stay on Loch Lomond side in Scotland last July. During that time I was specially studying the species of Water-beetles to be found in the small peaty holes upon the high moors. On the mountains, in peaty districts, the rain scours out holes and channels in the peat on the flatter parts, and in the holes water-beetles are to be found. June, 1905, was particularly dry in the Luss district, so that on my arrival at the beginning of July the peat holes were mostly dry. I visited in particular one hill in the neighbourhood, the top of which was about 1000 feet above sea-level, and noticed the hollows in the peat which were quite dry and hot with the sun. On this first visit, one hole had about a pint of water in it and contained about 7 specimens of *Hydroporus* of 3 or 4 species ; another hole was damp but overhung with a clump of sphagnum, which on squeezing yielded a little water and a few beetles. Except for these two places there was no visible water upon the patch of ground which I had determined to observe. On the night of the 11th and the early morning of the 12th July, there were about 12 hours' rain, and the weather cleared about 7 or 8 a.m. I re-visited the hill-top the same morning and found that all the holes contained water—and beetles. Some contained as many as 6 or 7 species including *Agabus bipustulatus*, a fairly large kind, individuals being common. Within a few days the water and beetles had again disappeared, and it was not until about the 30th of the month that heavy rain fell and re-filled the holes, which were again promptly tenanted within a few hours after the rain. One interesting point in connection with these observa-

tions was that two or three of these pools on the 12th of July contained each a few specimens of a rare species, *Hydroporus longulus*, Muls., and on the return of the water at the end of the month these same pools again all contained this species, while only one or two of the pools previously examined yielded it.

I have not had such favourable opportunities of observing the dykes and ponds in this district, but I have noticed that when a pond or dyke becomes re-filled after a drought, the same group of species reappears. For instance, where *Hydroporus gyllenhalii*, Schiödte, is the dominant species before the drought, it will as a rule be the dominant species when the water returns. A dyke, where for two seasons I have recorded *Hydroporus melanarius*, Sturm., has twice been dry for at least two or three weeks.

These facts seem to suggest that the Beetle fauna does not disperse on the drying up of a pond or dyke, but remains somewhere in the vicinity, probably in the cracks in the mud or among the damp herbage at the sides. If this surmise is correct it will account for the fact that the number of species per collection does not increase in the dykes and ponds which contain water all through the dry season, but it will not account for the decided falling off in the number of species per collection in July, 1904, a phenomenon which I certainly expect was repeated in July, 1905.

There are three hypotheses which might account for this falling off. One is that the *Hydradephaga* are more common in the dykes and ponds which tend to dry up in the summer; an assumption which necessitates the further assumption that the *Palpicornia* are more common in the dykes and ponds which do not tend to dry up, since this latter group does not show a falling off in July. A second hypothesis is that the high temperature of the water in the summer-time kills off a number of individuals of the *Hydradephaga* but does not affect the *Palpicornia;* while a third possibility is that there is an actual tendency on the part of the *Hydradephaga* to leave the water at the hottest season and seek shelter, perhaps in the damp earth in the vicinity of the pond. From

what I have said with regard to the Beetle fauna of temporarily dry ponds I am inclined to think that the third hypothesis is the most probable; but the evidence in favour of it is so far quite insufficient to establish it as a fact.

I will now re-consider the curves showing the number of species per collection in the light of the preceding remarks. I have shown that there seems to be evidence in favour of believing that the Water-beetles, both *Hydradephaga* and *Palpicornia*, only go through one cycle in the year and that the hatching time of the imagos is during the summer and early autumn months. We should, therefore, expect the distribution curve to rise steadily throughout the season, first in the spring because of the re-appearance of individuals which have hibernated, and later because of the emergence of new imagos. In the case of the *Palpicornia* the curve appears to be according to our expectation, and in the case of the *Hydradephaga* I have accounted for the July drop by assuming that these beetles tend to leave the water in the hot season.

Before we can explain the curves further we have to consider whether the *Hydradephaga* curve for 1904 or that for 1905 is to be taken as the normal one and how we are to account for the abnormality of the other curve. I have said that on certain premises we should expect the curve to rise steadily throughout the season, and I have endeavoured to account for the July depression, so the 1904 curve would appear to be the normal one. How then can we account for the abnormality of the 1905 curve? We have seen that it is probable that the months of September and October are to be accounted for by some conditions which affected similarly and injuriously both the *Hydradephaga* and the *Palpicornia*, so that what we have at present to account for is the low August distribution.

I have already referred to the parched condition of the marshes in August, 1905, and to the fact that the rainfall was actually greater than in the same month 1904. For the purpose of comparing the rainfall during the two seasons I have mapped out a chart from the figures given for Yarmouth

in the Weekly Weather Reports issued by the Meteorological Office. The six months March to August, 1905, were actually wetter than the same period in 1904, the mean being 2.23 inches last season as against 1.51 in 1904.

In the face of this the dry condition of the marshes in August last as compared with August, 1904, was perplexing, and it was not until I had mapped out a temperature chart and a chart showing the relative humidity of the atmosphere that the explanation occurred to me. The amount of water vapour that the atmosphere is capable of holding in suspension varies with the temperature, warm air holding more than cold air. At any given temperature a certain amount of aqueous vapour can be held in suspension and no more. The air does not, however, always hold in suspension the maximum amount, and the quantity actually held is measured by the hygrometer and recorded as the percentage of the possible amount and is called the relative humidity. If, therefore, we take the mean temperature for each month and also take the mean percentage of possible aqueous vapour held in suspension we get the mean relative humidity for each month. Now when the relative humidity is lower, the air is drier and consequently evaporation of water from the earth's surface will be greater. By referring to Chart 4 we see that for March, April, May and July the relative humidity was lower in 1905 than in 1904, while in June it was the same. Thus the dryness of the atmosphere during these five months was greater in 1905 than in 1904, the evaporation from the marshes was therefore greater, and the parched condition last year as compared with 1904 can be accounted for.

I believe that this excessive dryness accounts for what may be described as the failure of the autumn hatch of *Hydradephaga* imagos, which so far as I can see, is the only possible explanation of the low August distribution. The larvæ of both the *Hydradephaga* and *Palpicornia*, just previous to becoming pupæ, leave the water and burrow into the damp soil at the edge. Lyonnet found in the case of *Hydrophilus* that unless the earth is sufficiently moist the transformation cannot take place, and it seems not unreasonable to assume

that unless the earth remains sufficiently moist the pupæ will perish in the ground. If this explanation is the correct one, there is some evidence that the *Palpicornia* tend rather to inhabit waters less liable to dry up as their August distribution appears to be normal. Possibly, however, the excessive falling off in September of species per collection of this group may be accounted for by the fact that some of their pupæ had been reached by the excessive dryness.

The October portion of the curves of both the *Hydradephaga* and *Palpicornia* is, I think, to be accounted for partly by the fact that the marshes were then flooded, so that the individuals tended to become more distributed instead of being collected into the dykes, and partly by the fact that the mean temperature of the month was several degrees lower than that of October, 1904, which would tend to kill off some individuals earlier and cause others to hibernate earlier than they would otherwise have done.

I have in the present paper confined myself to a discussion upon the curves of species per collection per month, which I believe are now worked out upon a sound principle. I have endeavoured to correct some of the conclusions which I came to in my previous paper and have substituted others which, from additional observations, appear to suit the case more satisfactorily; but I am quite prepared for the possibility that after another season my present conclusions may again require re-forming. Almost nothing is known as to the habits of this group and I might almost say of any group of insects, and the manner in which physical and meteorological conditions affect these forms of life has so far scarcely received any consideration.

Entomology is still chiefly a playground for the collector, who sees nothing in an insect except an addition to his cabinet. Such an individual is of necessity a systematist since he names, not always correctly, the species which he captures and sends his doubtful lists to the entomological journals; he is often a man with little or no training or qualification for the work, but if he advertises himself sufficiently in the entomological papers he receives specimens for identification from

other collectors and becomes an authority upon this or that group. Hence entomology has come to be looked upon rather as a pastime than as a serious branch of biology.

More recently, however, the importance of the study of the life-histories of injurious insects with a view to their destruction, and the discovery of the connection between insects and certain human diseases, has brought trained biologists into the field and the bionomics of insect life has become important. Such work, therefore, as I have undertaken, although neither economical nor medical, is intended as an entomological contribution towards Biology, since it is an endeavour to trace the relationship between an organism, in this case an insect, and its environment.

XI.

NOTES ON THE HERRING FISHERY OF 1905.

By T. J. Wigg,

Honorary Secretary Great Yarmouth Section.

Read 27th February, 1906.

With the advent of brown October opens the greatest of all events in the life of the old town of Yarmouth, namely, the commencement of the great harvest of the sea, the Herring Fishery.

Reports were to hand from the North of a considerable shortage in the number of Herrings caught, owing to the bad weather, calms, and fogs on the East coast of Scotland. Off Yarmouth, the fishing started this year with stormy

weather, which greatly interfered with the success of the boats engaged. Consequently the catches during the first week were comparatively light. The real start was not made until the second week in October, when hundreds of Scotch and North country boats had assembled at Yarmouth and Lowestoft, and taking advantage of the bright days and lovely moonlit nights the boats were able to get to work for about a fortnight.

Nelson Centenary. Saturday, October 21st, was a very stormy day with a deal of rain, and as it was impossible to hold an open-air demonstration in front of the Nelson monument (which had been decorated with Nelson's famous signal, &c.), the fish salesmen, buyers, and many boat owners held an impromptu gathering under cover at the Fish Wharf during a lull in the business, when some hearty toasts were pledged to the hero of the day. This meeting drew together a motley gathering from all parts of the Wharf. Several songs, including "The Death of Nelson," "Heart of Oak," and "The Red, White, and Blue," were sung with great heartiness, and three times three cheers given with all the lung-power possessed by healthy fishermen and others connected with the business of the Wharf.

The closing days of October were very disappointing to the greater number of people engaged in the fishing. The boats certainly went out, and kept at sea, but Herrings were very scarce, as the boats appeared to be unable to drop upon the fish in any large quantities. All this reacted very seriously upon the business ashore, and as a result thousands of men and women, usually most busy at this season of the year, were walking about doing nothing. This state of things continued for nearly a week, and then fortunately a change took place and the fleet was able to go out of the harbour.

With the beginning of November a welcome change came and good catches were made by the majority of the boats, scores of which landed from ten to twelve lasts of fine Herrings. The whole of the Fish Wharf was occupied, and every one was busy, both here and on the gutting grounds, where hundreds of Scotch girls and men were busy through the day and far into

the night, the grounds being brilliantly lighted by means of hundreds of lamps of various kinds, and a walk round at eventide was a revelation, for from end to end of the long streets of troughs, one could see the rapid working of the lasses, and hear the strains of Scotch songs or some popular hymn with a swinging chorus.

After a few fine days in November a period of storm again set in, and on the 10th of that month the East coast was visited by one of the sharpest gales from the S.E. that has been experienced for many years. Happily the greater part of the fleet took warning, made for home and got into port safely. Strong gales from E. to N.E. with rain squalls caused business to be very slow for several days. The *Yarmouth and Gorleston Times* of November 18th, 1905, thus describes the scene in the harbour on Saturday, November 11th :—

"Saturday dawned very wild and threatening, and by daybreak a strong S.E. wind began to 'pipe up.' Soon after 6 a.m. hundreds of boats could be seen away to windward, with a spanking breeze on their lee. The boats, with every stitch of canvas set, came scudding across the roads and into the harbour, the scene as they crossed the Bar being a very exciting one, for they were able to dispense with the services of tugs. By 10 o'clock room was at a premium, and the cry was 'Still they come.' By 11 o'clock the gale had greatly increased in fury, by which time the great bulk of the fleet were in, but where to land their fish was what puzzled more. Every scrap of space was crowded with boats, waiting for turns, and as far as the bridge on both sides of the river boats were to be seen disgorging themselves of their catches, necessitating long distance carting in order to reach the Wharf. The scene looking seaward from the gutting grounds was extremely wild. Amid the scud, steam drifters could be seen struggling up from the North in the face of the gale, and coming into port, glad enough to get between the Piers. The scene in the harbour was one of stir and bustle all day long, what with the gale and the rush in of the fishing fleet. To add to the inrush, over 200 boats, fishing out of Lowestoft, finding the gale increasing, ran into

this port for safety, and helped to swell the big fleets already in port. From the Ballast Quay up to the ferry, Scotch boats lay end on, and on the Gorleston side hundreds of boats were moored, but finding the 'range' very heavy great numbers sailed Yarmouthwards, and very soon right up to the bridge fishing craft lay moored four and five deep, and completely put an end to navigation. Looking from the bridge only a very narrow channel could be seen, while on all sides a vast forest of masts and funnels could be seen as far as the eye could reach. There was, however, no blockade such as used to be the case, and great credit is due to the harbour staff for the able way in which they manipulated the business under very trying circumstances."

With the first week in December, preparations were made by the Scotch for a return to the North. Numbers of men and women could be seen day by day wending their way to their boats or lodgings loaded with parcels, in many cases one might well say overloaded. Local tradesmen must have benefited very greatly at a time when business would otherwise be notably quiet. It is estimated that Yarmouth has been visited during the fishing season by considerably more than 14,000 people, all connected with the Herring fishery, and their spending would average about 20s. per week. The Scotch boats as a rule have done remarkably well during the fishing, as prices have ruled high, and, with the exception of a few days, the weather was very favourable for fishing. Some of the Scotch crews have earned for six weeks' work, sums varying from £200 to £600 each, while the steam drifters —Scottish and English alike—mostly reckon their earnings in four figures.

About half a million of money has been paid at Yarmouth and Lowestoft together for fish as taken out of the boats. This is no exaggerated estimate, and means that fishermen and boat owners have had one of the best seasons in the history of the Herring trade. While the fishermen have thus reaped a rich harvest, it is very unfortunate that those who find the capital for the Herring industry cannot be congratulated on similar grounds. When Herrings are fairly plentiful

—as is the case this year—the season is usually a good one for fishermen and merchants alike. But the current season, not only at Yarmouth and Lowestoft, but right from the start in May has been "a fisherman's year," and nobody else has been "in it."

I notice that there has been less "telling" from the boats this year. Most of the calculations are now made by means of the Scotch cran of a thousand fish, and the prices quoted have generally been at so much per 100 or at per cran.

The value of the Herring fishery to all towns where the industry is carried on may be gauged from the following figures. At an average of 25s. per cran—not an extravagant estimate—the value of Herrings landed at Yarmouth alone to December 2nd, amounts to the large sum (in round numbers) of £477,000. Of this total the Scotch boats have earned over £230,000 and the local boats over £240,000. Adding to this the value of the Lowestoft fishing—say £355,000—and the expenses of workers' wages, merchants' profits, transit to market, &c., before the Herrings reach the tables of the consumers, we find that something like a million pounds sterling has been paid for the East Anglian fishing this year.

Owing to severe N.W. gales at the beginning of the season in October, a number of Yarmouth luggers reported the loss of all their nets, and a Kirkcaldy boat reported the loss of a hand who was washed overboard and drowned. The Scotch fleet lost several boats during the season, but fortunately the crews were saved.

"The question of Sunday fishing on the part of the Yarmouth boats has long been discussed; but nothing seems to come of it, the contention being that the local boats have the run of Monday's market. That may be so, but it is a well-known fact that this sort of thing generally leads to prices being kept low, which would not be the case if all the boats kept in port for a couple of days. It is a noteworthy fact that the top boat at the Westward fishing was a boat that on Sundays kept in the harbour. Much is argued for and against the practice, but the evidence in favour of a general cessation is by far the strongest."—*Yarmouth and Gorleston Times.*

A unique advertisement. At the conclusion of the Yarmouth Herring fishery, when the Scotch girls were leaving for the North, they were much surprised to find themselves the recipients of a very useful Christmas-box, the gift of Messrs. J. & J. Colman of Norwich. Agents from the Carrow Works gave to each of these people a case containing full-sized samples of the various household requisites manufactured by the firm. Each case contained mustard, starch, washing blue, self-raising flour, corn flour, semolina, &c. It is needless to say that the women were very demonstrative in their thanks.

I feel that I am again indebted to Mr. W. Lewis Smith and Mr. H. J. Henderson for particulars of the number of Herrings landed at the respective ports of Yarmouth and Lowestoft.

RETURNS OF HERRINGS LANDED AT YARMOUTH IN 1905.

Month.	Lasts.	Month.	Lasts.
January	—	Brought forward	163
February	—	July	19
March	12	August	616
April	78	September	1,368
May	10	October	14,321
June	63	November	19,229
		December	2,791
Carried forward	163	Total	38,507

Number of Yarmouth boats employed, about . . 190
,, Scotch and other boats employed, about 540

RETURN OF HERRINGS LANDED AT LOWESTOFT IN 1905.

Month.	Lasts.	Month.	Lasts.
January	—	Brought forward	862
February	—	July	14
March	88	August	13
April	679	September	88
May	58	October	10,888
June	37	November	15,277
		December	2,325
Carried forward	862	Total	29,467

Number of Lowestoft boats employed . . . 224
,, Scotch and other boats employed . . 440

XII.

SOME ADDITIONS TO THE NORWICH CASTLE-MUSEUM IN 1905.

By Frank Leney,

Assistant Curator of Museum.

Read 27th March, 1906.

Among the additions to the Natural History Collections during the past year which are of interest to this Society, are male and female specimens of the Skomer Vole (*Evotomys skomerensis*) and females of the Orkney Vole (*Microtus orcadensis*) presented by Mr. R. Drane of Cardiff; they represent new species, or at any rate well marked local varieties.

Dr. Chas. Hose, British Resident in Sarawak, presented a "nest" of the Orang utan (*Simia satyrus*) from Borneo. This donation is of much importance as there are but two or three nests to be seen as yet in any Museum, and it is anticipated that it will be practicable to have an Orang utan and nest set up in accordance with Dr. Hose's observations on the habits of these animals. Dr. Hose said that the "nest" is really a number of branches crushed down on to a bough of a tree to form a screen from the wind, so that the Orang can watch in comfort until the neighbouring cultivated fields are left unprotected.

By the gift of three plates of whalebone by Mr. R. C. Haldane, of Ronas's Voe, Shetland, the Museum now possesses examples of the baleen of all the British Balænopteridæ, but that of the Atlantic Right Whale (*Balæna biscayensis*) is still a desideratum.

Mr. Harvie-Brown presented a pair of Yellow-breasted Buntings (*Emberiza aureola*) to represent a species recently added to the British List.

Mr. J. H. Gurney was able to reduce his list of desiderata by the acquisition of a rare Owl, and has kindly sent the following note :—

"The only addition to the Raptorial Collection during 1905 is a South American Owl, *Syrnium rufipes* (King), from Valdivia, Southern Chili (A. v. Lossberg). Of this handsome Owl my father remarks in his MS. notes, 'A small member of the same group as *Syrnium nebulosum*, *S. fulvescens*, and *S. occidentale* . . . a very distinct species'—and as such a welcome accession."

A notable addition to the Fish corridor is that of a magnificent specimen of the Tarpon or Silver King (*Megalops thrissoides*), weighing 185 pounds and measuring 7 feet in length, taken by the donor, Mr. Hugh Gurney of the British Embassy, Washington, with rod and reel at Fort Myers, Florida, U.S.A., on April 22nd, 1905.

Although not within the scope of this summary, it will be of interest to this Society to know that an old time Norwich Naturalist—Sir Thomas Browne, M.D.—is represented in the Museum, through the generosity of Mrs. Martin Hood Wilkin, by a choice collection of his published works, including the very rare first and second unauthorized editions of 'Religio Medici,' as well as a MS. copy in Sir Thomas' own handwriting; the collection being of the utmost importance to all students of Sir Thomas Browne's works.

The Museum was visited by 118,186 persons during the twelve months ending December 31st, 1905.

XIII.

NATURAL HISTORY NOTES FROM YARMOUTH.

By A. H. Patterson.

Read March 27th, 1906.

1905.

Owing to a severe illness during the first three months of the year, my note-book contains little of natural history interest during that period.

During the latter half of March a more than usual number of Ballan Wrasses (*Labrus maculatus*) were taken in the shrimpers' nets. Those taken here are seldom longer than one's hand; one of a decided venetian-red colour measured 11 inches. Most of the examples met with were of the green variety.

Late in March a southward migration of some species of Cetacea was observed off the Norfolk coast. They were variously stated by casual observers to be "Scoulters" (White-beaked Dolphins), Grampuses or Porpoises. Mr. Lowne, of Fuller's Hill, saw the shoal passing Yarmouth (on the 19th), their "ranks" extending, he stated, almost from the Wellington Pier to the St. Nicholas Lightship. Three or four at a time sprang from the water, and all were merrily making south. He thought they seemed about 6 feet each in length, and were, in his estimation, Porpoises. They must have mustered two or three hundred.

April 4th. Notwithstanding the poisonous atmosphere of a small public-house bar, a Cuckoo that had been taken the previous spring from the nest, was still alive and in fairly good plight. It was feeding on a strange mixture (for a Cuckoo) of sliced beef, seeds, and bread and milk. It died a few months after.

April 26th. Nine Land Dotterel (*Eudromias morinellus*) were seen on the North Denes.

May 7th. There was no great show of spring migrants on Breydon this year. About a dozen Bar-tailed Godwits (*Limosa lapponica*) turned up on the beach with a few Grey Plovers on May 7th, and two Kentish Plovers (*Ægialitis cantiana*) seen on Breydon on the same date; Godwits were heard overhead on the night of the 8th.

May 11th. Considerable number of Ringed Plovers on Breydon, with some Dunlins and a few Sanderlings. The water seemed alive with those high-swimming crustaceans, *Idotea linearis*.

Three adult Wigeon, all fine males, were observed as late as May 13th; they came quite close to me as I sat in the stern sheets of my house-boat.

May 19th. The Swifts (*Cypselus apus*) did not put in an appearance until this date, when two pairs visited the old High Mill (since pulled down). It was a cold bleak day, and they were very noisy; the wind was N. They disappeared next day and were not seen again until the 23rd. At a house on the North Quay, for many years a resort of these birds, one was seen by Mr. Stagg, the occupier, on May 13th, it left again almost at once; but on the 19th several visited the spot.

May 25th. Saw a Dunlin "worming" on the very soft and slimy ooze at the entrance of Duffell's drain, at low water; repeatedly running several yards to dip its prey in the water at the extreme edge before swallowing it.

On the same day I saw a very fine example of the Sea Angler (*Lophius piscatorius*) lying at the Quay side, having been taken that morning in a shrimp-net. I estimated its weight at a good half-hundredweight.

May 27th. Dunlins, in full breeding attire, were still to be seen on the "flats."

On the same day myriads of small black Flies (probably a species of *Actora*) floated across Breydon on the early part of the ebb; some Starlings, hovering over the surface, were snatching them up, after the fashion of the Gulls.

May 30th. A shy and restless collection of Wimbrel Turnstones and Ringed Plovers spent the night on Breydon: and a Water Rail, killed by striking the telegraph wires, was shown me. It must have been a migrant.

May 31st. The stomach of an Eel that had been netted in a ditch was brought me on May 31st. It was packed with eggs of the Three-spined Stickleback.

June 8th. An example of the Rose Perch (*Scorpæna dactyloptera*) was taken by a shrimper, length 7½ inches.

June 11th. I spent a most delightful hour, in company with Dr. S. H. Long, on Wells foreshore, among the Nesting Terns, which include the Little Tern and the common species (*vide* 'Zoologist,' July, 1905). Every Norfolk naturalist should make a pilgrimage, once in his lifetime, to this interesting locality.

June 12th. I saw some Common Terns on Breydon, and some Little Terns on the 13th. Surely they came a long way for a change of scene and occupation!

June 13th. Spent a very enjoyable evening hour watching a flock of nine Avocets on Breydon. At 7.30 I saw them in a compact flock on the wing; they sailed around for a half-mile and then alighted in shallow water. The tide was just at the full, and in a very short time I saw them off their feet entirely. They swam with the buoyancy of Tufted Ducks, which, at a distance, they greatly resembled, as they bobbed up and down on the ripple, with their heads drawn in. I pushed to within a hundred yards of them, and distinctly saw they were swimming; one and another occasionally popping its head under water, as if to reach the bottom, keeping the tail perpendicular by the aid of the feet, as ducks do. A small Gull accompanied them. I put them up, when they flew around in extended line, wheeled once or twice, and again settled, this time near the "Lumps." It was a sight to be long remembered.

I think one had been touched with a shot, as it seemed slightly lame; and I am not sure that the whole of them subsequently got away safely.

A nest of Ringed Plovers was discovered early in June, on the South Beach.

June 22nd. A remarkable Crab-claw was shown me. The "free" chela on the larger claw exactly resembled a bird's head, the point turning like the beak of a Rook, and a spot, on one side, even did duty for the eye!

July 2nd. Saw a White Stork on Breydon early this Sunday morning, not a great way from my house-boat. It was very restless, and quickly disappeared. Woodcock flushed near Breydon, same date.

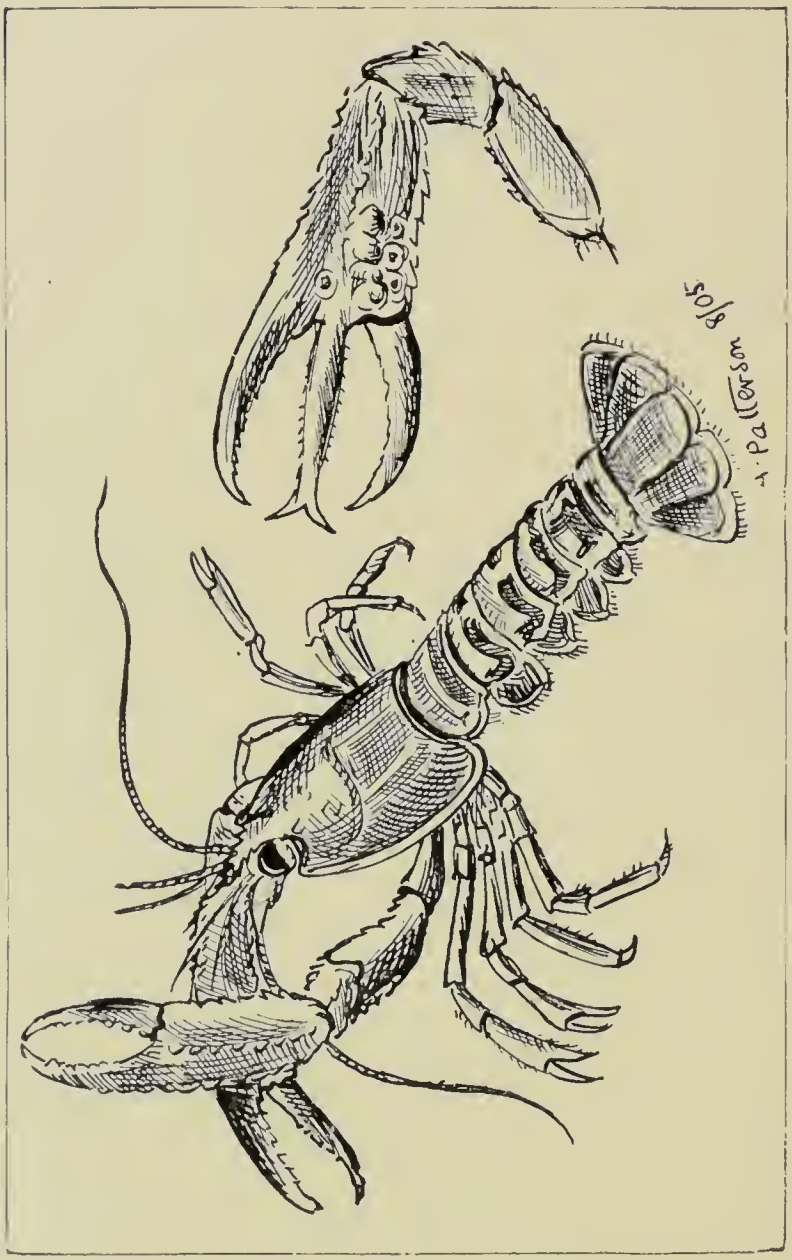
July 4th. A hybrid Turbot-Brill, weighing about 3 lbs., was shown me.

July 6th. A flock of 60 Jackdaws were very busy feeding on a marsh near the Bure; among them were undoubtedly at least a score bred in our own parish church steeple.

July 13th. Some considerable number of immature Herons, Redshanks, Dunlins, with a few Greenshanks and a Wimbrel feeding on the flats. Some young Starlings were picking up small crustaceans and *Hydrobia* off the stranded "Wigeon Grass."

A great mortality occurred among the Eels at the end of July. Hundreds turned up during a continuance of hot weather, dying probably from asphyxia, or from the poisonous exhalations of over-heated mud and decaying vegetation.

August 6th. Spent a quiet Sunday in the house-boat on Breydon, reading, feeding, and bird-watching, "far from the madding crowd" of a Bank-holidaying throng in town. Was much interested in observing a Black-headed Gull seize an Eel about as thick as my finger, which he discovered among the stranded "grass." It took some pains to shake and weary the fish, another Gull offering to assist. Number one flew up and away with his prize, preferring to negotiate matters alone, and making for a safer locality. Left alone, he tried harder to overcome and swallow it, and succeeded in taking in half, but the Eel, objecting to this course, twisted its tail round the Gull's upper mandible, and backed out. Two or three times the Eel was swallowed and vomited by the persistent bird, and then finally bolted; the last time the



NORWEGIAN LOBSTER.

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swallower craning his neck to its full length, when the gradually subsiding contortions of the imprisoned fish were plainly seen. The Eel at length settled quietly to its fate, and the triumphant Gull went to the nearest puddle for a sip on the strength of it.

A flock of 70 Wimbrel flew in from sea, on the same date; spread out like a fan as they lowered to the flats, allowing me easily to count them, then altering their minds, closed up again and kept on westward. A Cormorant was also on Breydon.

August 15th. Quite a number of Little Terns (*Sterna minuta*) on Breydon, on the higher flats: some of them were fledgelings: these squatted about while their parents fished in the "Ship" drain, and made quite a display of fuss and flutter when the silvery little victims were brought to them, squealing very much like young Starlings, their elders "cheeping" loudly when coming to their respective offspring.

August 17th. A most remarkable pincer claw of a Norwegian Lobster (*Nephrops norvegicus*) was brought to me; between the moveable and the fixed chelæ was another fixed chela, slightly longer than either of the others, the end of it forking after the fashion of a Herring's tail. Larger numbers of these crustaceans were brought to Yarmouth this year than ever before, and were readily purchased.

The night of August 26th was remarkable for the immense numbers of migrating Waders which, arrested in their flight by atmospheric disturbances, hovered over many of our East Coast towns. A perfect babel of bird cries, emanating from Redshanks, Grey Plovers, Lapwings, Dunlins, Ringed Plovers, and many others, made the night hours weird and startling. By dawn the spell of the lights below had passed and the birds moved on.

September 4th. I had brought me from Upton a live Lobworm, from the centre of which two perfect tails diverged.

In September, a little party of Stoats took up their residence on Breydon walls, near the "Fleet" (half way on the north side to Berney Arms), and rats diminished in an exceedingly short space of time.

September 14th. A 13-inch Haddock was brought me singularly curved at the posterior end; a half circular depression being formed between the second and third dorsal fins. On dissection I found two knot-like processes in the backbone, caused by an enlargement and coalescence of the vertebræ, each the size of acorns.

September 18th. An inrush of Golden Plovers took place at night, and several were brought to market the next day.

September 20th. Some Little Stints (*Tringa minuta*) on Breydon.

September 28th. After a series of easterly winds, as is my usual custom, I patrolled the beach, examining the flotsam thrown up at the tide-mark in search of stranded sea-birds. My quest was rewarded by finding a dead Manx Shearwater (*Puffinus anglorum*), in an exceedingly emaciated state. On the same date (September 28th) I saw some mischievous boys stoning a wearied-out Red Throated Diver (*Colymbus septentrionalis*) wave-muddled and tamed. A very immature Guillemot and a Razorbill were thrown ashore among the seaweeds.

September 29th. First Woodcock in the market.

October 9th. A Storm Petrel was brought me alive. It had been taken on board a fishing lugger. With very little difficulty I got it to nibble at a Herring-roe held between my fingers; itself meanwhile sitting contentedly in my left hand. It swallowed minute portions of ova, accompanying the process by much head-shaking; it would dig out pieces, as Gulls snatch out lumps of flesh from a decomposed carcase, with a backward movement. A second Petrel was brought me alive on November 7th, but died shortly after.

Grey Phalarope (*Phalaropus fulicarius*) shot on Breydon early in October.

October 10th. Rooks and Siskins arriving.

October 13th. I estimated about 4000 Gulls on Breydon; 3000 at least were Black-headed Gulls, the others mostly Black-backed Gulls in various stages of plumage; and there were a few Common Gulls.

Hundreds of Golden Plovers frequented Breydon early in

October; a rather unusual resort for this marsh-loving species.

October 14th. Saw my first Snow-bunting of the year, busily employed among the seeds of the Michaelmas Daisy (*Aster trifolium*) on Breydon walls. A couple of Swallows "set upon" it as they passed; an incident suggesting their dislike to these harbingers of wintry days.

A Yellow Wagtail on the Breydon marshes as late as Oct. 14th.

A Glaucous Gull reported to me by a gunner as consorting with the many "Grey" and Black-backed Gulls at the harbour mouth, for some time in October. It managed to keep beyond gunshot, but at length met its fate on Breydon. It was a singularly white Gull.

Rooks "pouring in" latter end of October. Hooded Crows coming over in straggling flocks.

Redbreasts much in evidence during the first week in November—many of them undoubtedly migrants.

November 8th. I saw a fine example of the Scad or "Horse-mackerel" (*Trachurus trachurus*) taken in a draw-net on Breydon. And a number of Sprats, most unusual there, were taken about the same time.

November 10th. A "Ringed" variety of the Guillemot was shot near the harbour mouth.

November 11th. A third Storm Petrel was brought in by a fishing-boat.

When strolling from Gorleston to Corton by the beach on the afternoon of November 15th, I was pleased to see a flock of at least 200 Scoters "riding at anchor" and fishing in the roads. There is a sort of "hard ground" bottom here, where the Shrimpers find much *Sabellæ*, and other "dross," as they term it, and a goodly bed of Radiated Trough Shells (*Mactra stultorum*), and the Scoters find much to interest them.

November 14th. Wind S.E. On the 15th a number of Grey Plovers in the neighbourhood.

November 17th. A pair of Bearded Tits seen at St. Olaves. I afterwards saw the male bird—*dead*. Their unusual appearance at St. Olaves would suggest a likely return to an old nesting haunt.

November 28th. A full grown Herring, on whose left side was an unsightly tumour about the size of a two-shilling piece, was brought me. The fish was in an emaciated condition, and exhaled a most unwholesome odour. After roughly sketching the wretch I cremated him. This is the second example similarly afflicted which has come to my notice.

December 15th. A Woodcock weighing 12 ounces hung in the market; it had a bill only 2 inches long.

Mus alexandrinus turned up rather more numerously in November and December than heretofore; whilst *Mus rattus* has in no way diminished in numbers in the town.

December 18th. Saw a 12-inch Plaice, the tail of which exhibited a queer half-turn; the tail itself was doubled over on one side, the membrane being so connected that it formed a tunnel-like hollow, up which I easily ran my pencil.

XIV.

MISCELLANEOUS NOTES AND OBSERVATIONS.

Wild Bird Protection on the Norfolk Coast.—Those who have read in the 'Birds of Norfolk' the sad story of the persecution suffered by the shore-breeding birds on the Norfolk Coast, even so late as the year 1890, and regretted the rapid process of extermination which then seemed to threaten these interesting visitors, will rejoice in the beneficent change which has been brought about by the strict enforcement of the enactments for the protection of Wild Birds. Certain species, such as the Bittern, Black Tern, Godwit, Avocet, and Ruff were lost to us beyond recall, and the Common and Lesser Terns, with the Great

Crested Grebe and Sheld-duck, were rapidly following; but now, happily, all the latter are as steadily increasing in numbers, and even the Bearded Tit is more than holding its own, whilst the former long death roll of slaughtered passing summer migrants is annually replaced by a list of rare species observed. It is no longer needful to speak with bated breath of the precise nesting resorts of the gregarious shore-breeding birds, for there are no less than four Societies, all supported by voluntary contributions, employing watchers for their protection, the reports of which, for 1905, we have received, and they are most encouraging.

The first of these, taking them seriatim, is the Wolferton Society, to which H.M. the King is the largest contributor, ably seconded by H.R.H. the Prince of Wales, who takes a personal and active interest in the objects of the movement, the results of which are reported to be satisfactory in every way, the past five seasons having greatly increased not only the numbers both of the Greater and Lesser Terns and Ring Dotterels breeding on the fore-shore, but also those of the Sheld-ducks. The watcher takes great interest in his duties, and has supplied valuable notes on the species over which he is appointed guardian to the Hon. Secretary, Mr. George Cresswell of Hunstanton, and those who have visited the breeding places expressed their great pleasure at the manner in which the work has been carried on and the progress made in the efforts to re-establish the all but exhausted colonies.

Blakeney and Cley.—Here again the results have been most satisfactory; Lord Calthorpe, the principal owner of the fore-shore, being the chief supporter of the Society, but the amount subscribed appears to be lamentably small for the work to be accomplished, only about £10 being at the disposal of the Hon. Secretary, Mr. Q. E. Gurney of Northrepps Hall, who would be glad of further support. The chief enemies to the birds,—plume hunters and eggers,—have been effectually banished from all the nesting localities, but rats and stoats are very troublesome, and have

to be effectually disposed of as early as possible ; this was successfully done here as to the former, but the Stoats were very troublesome. The watcher contributes some interesting notes as to the dates of arrival and nesting habits of the various species.

Wells.—Here the nesting ground is very extensive, and in some parts subject to flooding during exceptionally high tides. The Earl of Leicester is the principal proprietor, and the good work has been successfully carried out at an even less expenditure than at Blakeney. The Hon. Secretary, Mr. C. A. Hamond of Twyford Hall, having only about £8 at his disposal, earnestly asks for further help. Rats have for some years been very troublesome in this locality, but they were attacked early in the season, and in the absence of gales and floods, more Terns of both kinds, Dotterels, Redshanks, and Sheld-ducks were hatched off than in any previous season, and nothing tended to check the natural increase of the various species.

Breydon Wild-birds Protection Society.—Here the work of the Society is devoted mainly to maintaining a watcher, who inhabits a house-boat on the Broad during the close time, and his duty is to warn off prowling gunners seeking the destruction of the rare species which annually make this celebrated locality a resting place on their periodic migrations. The Hon. Secretary, Mr. H. P. Frederick of Great Yarmouth, presents a very favourable report to his subscribers, and the excellent results of the Society's operations may be judged from the fact that the usual spring "trips" of land Dotterels, Whimbrels, two Black-winged Stilts, Spoonbills and Avocets, with many other less rare birds, have passed on their way unmolested, and the watcher has made notes of all the more noteworthy migrants.

The benefits conferred by these inadequately supported Societies can hardly be too highly estimated ; so far as Norfolk is concerned the supply of material for the hateful plume trade is effectually cut off, at least, during the breeding season when the birds are most easily obtained ; and it is to

be hoped that the interest evinced by the King in their protection, added to the gracious letter to the Royal Society for the Protection of Birds from the Queen, whose kindness and humanity to all living creatures is so well known, may at length have the effect of emphasising the disgust long felt by all right-minded people at the horrid displays of mutilated birds, which are supposed to add to the attractiveness of feminine adornment.—T. S.

Wild Geese Killed by Lightning.—About 9 a.m. on the morning of the 8th of February, my attention was drawn to a sharp drop in the barometer, which continued to fall until 2 p.m., when a violent storm of quite twenty minutes duration, accompanied by snow and much lightning, blew up from the north-west. Such a combination is unusual, and it greatly affected the large flocks of Pink-footed Geese, which to the number of 3000 annually make Holkham and Wells their winter quarters; alarmed by the thunder and blinded by the snow, they flew about, exposing themselves and suffering in consequence from the lightning.

No less than nineteen Wild Geese were killed whilst on the wing by the lightning, as I am informed by Mr. H. M. Upcher, who was near the scene at the time. I learn from him that these were picked up in four adjacent parishes, viz.: in Weybourne, Kelling, Bayfield, and Holt; in the latter, five fell on the school football ground, as mentioned in 'The Field' of February 24th, by Mr. J. G. Woods.

The dead birds consisted of 15 Pink-footed Geese, and 4 White-fronted Geese. Most of them were lying on their backs when found, and showed an abrasion on the upper side between the wings, amounting in one case to a ragged hole, three inches long. One or two are said to have been uninjured, but possibly a close examination beneath the feathers would have revealed the mark of the electric current somewhere.

Various trees and cottages were struck by the lightning, but the only other feathered victim was a Greater Black-backed Gull, which fell in a field of Mr. Russell Colman's at

Corton, near Lowestoft. As this bird came more particularly under the notice of Mr. Southwell, I have asked him to supply a short account of it.—J. H. Gurney.

Through the kindness of Mr. Roberts, to whom the Gull referred to above by Mr. Gurney was sent for preservation, I had an opportunity of thoroughly examining the bird, and sent a full description of the *post mortem* appearance, both externally and of the viscera, to the 'Field' of March 10th, 1906.

Externally there was a track quite denuded of feathers about three-quarters of an inch wide, extending from the right carpal joint along the anterior margin of the wing, obliquely across the breast, and terminating on the left side of the abdomen; the skin was not broken, and there was no discoloration.

On removing the skin, there was no apparent trace of the passage of the electric current, and the abdominal wall was not perforated—a slight discoloration where the external track ended, I attributed to another cause as the bird had been dead twenty days. The viscera was healthy, and there was no apparent cause of death, which probably was caused by constitutional shock.

The remarkable feature of this storm was, I think, its destructive effect on so many birds over a wide-spread area. When we consider that a bird in mid-air is completely insulated, the rarity of such accidents is not surprising; for it seems that to meet with such a fate the bird must come directly within the path of the discharge, and the fact that so many were killed, over so wide a tract of country, extending from Corton in the extreme north-eastern coast of Suffolk, to Holt (some miles inland) and Cley on the coast of North Norfolk, must have been the result of several separate electric discharges, although in the same storm, and surely must indicate an electrical condition of the atmosphere of very rare occurrence.—T. S.

XV.

OBITUARY NOTICE.

Lieut.-Colonel Leonard Howard Loyd Irby.

By the death of Colonel Irby, which took place at his London residence on 14th May, 1905, we have to lament the loss of an accomplished Ornithologist of Norfolk origin, and a Vice-President of our Society.

The son of a distinguished father, the late Rear-Admiral the Hon. Frederick Paul Irby, C.B., Col. Irby was born at Boyland Hall in 1836, and educated at Rugby; he entered the army as Ensign in the 90th Light Infantry in May, 1854, and proceeded almost at once to the Crimea, where he served throughout the winter of 1854-55, and was present at the siege of Sebastopol. In 1859, on his way to China (one of his fellow-captains being Garnet Wolseley), he was wrecked in the Straits of Banca, in the unfortunate troop-ship "Transit," and on being taken off by the "Dove," the troops were diverted to India where the Sepoy Rebellion had broken out. After a march of 700 miles from Calcutta, they reached Cawnpore, shortly after the massacre, and he saw much hard fighting at Lucknow and elsewhere under Clyde and Outram. He returned to England in 1860, and after seeing service at Gibraltar and the Mediterranean, retired from the army with the rank of Lieut.-Colonel in 1874.

From his earliest years devoted to Natural History, Irby lost no opportunity of pursuing his favourite pursuit, and in later years his stay at Gibraltar led him to the study of the birds of the Spanish peninsula, a then practically unexplored ornithological region, in which he was associated with the late Lord Lilford; this led to the publication of his

'Ornithology of the Straits of Gibraltar,' in 1875 (second edition 1895), which with a very useful 'Key List of British Birds' (1888, second edition 1892), I believe formed his only separate works; indeed, Irby, like many another best qualified to do so, is said to have had "an invincible objection" to publishing any account of his great experiences, "and had an utter contempt both for mere scribblers and 'collectors.'"

Irby's connection with our Society commenced in 1886, and he was elected a Vice-President in 1903. Although, probably for the reasons stated above, he was never a contributor to our 'Transactions.' He took great interest in the affairs both of the Society and of the Castle-Museum, and contributed some valuable works to the libraries connected with these institutions, to which it was his expressed intention largely to add; but unfortunately this was frustrated by his somewhat sudden death. To the Museum he made his first contribution in 1857, and from time to time greatly enriched the collection of Birds' Eggs; his last gift being his valuable collection of British Lepidoptera in two large Cabinets in June, 1902.

Col. Irby was one of those painstaking and conscientious workers which, unfortunately, are becoming rare, and the work he has left on the birds of S.W. Andalusia, is still, and likely to remain, the standard authority on the ornithology of that interesting district.—T. S.

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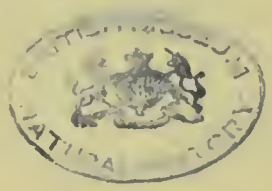
13 JUL. 1906



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Ladies or Gentlemen distinguished for their attainments in Natural Science, or who have rendered valuable services to the Society, may be nominated by the General Committee as Honorary Members, and elected by a show of hands at the next meeting of the Society. Such Honorary Members have all the privileges of Ordinary Members.

CONTENTS.

	List of Officers	v
	List of Members	vi
	Statement of Accounts	x
	Catalogue of Additions to the Library	xi
	President's Address	155
I.	Letters from Hamon le Strange and Robert Marsham, F.R.S., preserved at Blickling Hall. By Thomas Southwell, F.Z.S., V.-P.	175
II.	Stratiotes Aloides, L. By Alice M. Geldart	181
III.	*Mertensia Maritima*, Gray, in Norfolk. By Mr. W. H. Burrell	201
IV.	Notes on the Arctic Whale-fishery from Yarmouth and Lynn. By Thomas Southwell, F.Z.S., V.-P.	202
V.	The Classification of Norfolk Flint Implements. By W. G. Clarke	215
VI.	*Holosteum umbellatum*, L., *Statice reticulata*, L., and *Phleum boehmeri*, Wibel. By A. Bennett, F.L.S.	231
VII.	Meteorological Notes. 1905. By Arthur W. Preston, F. R. Met. Soc.	239
VIII.	Suffolk Fungi. By Rev. E. N. Bloomfield, M.A.	246
IX.	A Preliminary Sketch of the Bionomical Botany of Sutton and the Ant District. By W. A. Nicholson, *Hon. Sec.*	265
X.	A Study of the Aquatic *Coleoptera* and their Surroundings in the Norfolk Broads District. By Frank Balfour Browne, M.A., F.R.S.E., F.Z.S.	290
XI.	Notes on the Herring Fishery of 1905. By T. J. Wigg, *Hon. Sec. Gt. Yarmouth Section*	307
XII.	Some Additions to the Norwich Castle-Museum in 1905. By Frank Leney	313
XIII.	Natural History Notes from Yarmouth. By A. H. Patterson	315
XIV.	Miscellaneous Notes and Observations	322
XV.	Obituary Notice. Lieut.-Colonel Leonard Howard Loyd Irby	327

26 AUG. 1907

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30 AUG. 1907

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1 „ 1899—1900	0	5	0	„ Fletcher and Son, Printing *Transactions*	48	13	6
1 „ 1900—01	0	5	0	„ Ditto Sundry Printing	0	11	6
1 „ 1901—02	0	5	0	„ Goose & Son, Sundry Printing	3	14	0
3 „ 1904—05	0	15	0	„ Illustrations in *Transactions*	0	18	2
13 „ 1905—06	3	5	0	„ Postage (Hon. Sec.)	5	13	5
171 „ 1906—07	42	15	0	„ Ditto (Assistant Sec.)	0	15	0
4 „ 1907—08	1	4	0	„ Insurance	0	9	0
	48	19	0	„ Year Book of Societies	0	6	0
„ Additional payments for Notices	0	15	0	„ Norfolk and Norwich Library, Use of Room	1	1	0
„ Sale of *Transactions*	7	2	3	„ Gratuity to Museum Doorkeeper	1	0	0
„ Donations	3	13	2	„ Assistant Secretary's Salary	5	0	0
„ Grant from Life Membership Fund	10	0	0				
„ Interest on Life Membership Fund	1	12	10				
„ Balance due to Treasurer	5	6	6				
	£77	8	9		£77	8	9

LIFE MEMBERSHIP FUND.

	£	s.	d.		£	s.	d.
1906.				1906.			
To Balance at Post Office Savings Bank	70	0	0	By Transferred to Current Account	10	0	0
„ 2 Compositions for Life Membership	10	0	0	„ Ditto	1	12	10
„ 1 Additional Composition	1	0	0	„ Balance in Post Office Savings Bank	71	0	0
„ Interest to Nov., 1906	1	12	10				
	£82	12	10		£81	12	10

Norwich 25th March, 1907.

Examined with vouchers and found correct,

STEPHEN WM. UTTING, *Auditor.*

List of the Publications received by the Society as Donations or Exchanges from March, 1906.

AGRICULTURE and Rural Affairs, Essays relating to. By James Anderson, LL.D. 3 vols. 1784 and 1796.
Presented by Mr. J. H. Gurney, F.L.S., F.Z.S.

ANAGALLIS arvensis and A. cœrulea. James Edwards. Reprint from Journ. Bot., November, 1906. *Presented by the Author.*

BACILLARIA and Infusorial Earths in U.S.A. Four pamphlets. By Arthur M. Edwards, M.D. *Presented by the Author.*

BATH Natural History and Antiquarian Field Club. Proceedings of the. Vol. xi. No. 1. 1906.

BELFAST Naturalists' Field Club. Annual Report and Proceedings. Series II. Vol. v. Part 5. 1905—06.

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BIRDS of Nottinghamshire, Notes on the. By J. Whitaker. Nottingham, 1907.
Presented by Mr. J. H. Gurney, F.L.S., F.Z.S.

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COLD Spring Harbor Monographs. vi. The behaviour of the Pond Snail (Lymnaeus elodes, Say). 1906. Brooklyn, N.Y.

CROYDON Natural History and Scientific Society, Proceedings and Transactions. 1906.

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Entomology. An Index Companion to Mr. Curtis's British Entomologist, being a descriptive Enumeration of all the British Species, and distinguishing such as have been found in Norfolk, etc. M.S. Book belonging to late Mr. Brightwell. *Presented by Mr. Walter Rye.*

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——— Vol. xliii. No. 4, Westindische Polychaeten (Agassiz Expedition). Vol. xliii. No. 5. Eine neue Myzostoma Art. von August Reichensperger. Vol. xlvi. No. 14, Certain Scopelids in the Collection of the Museum of Comp. Zoology. By Charles U. Gilbert. Vol. xlviii. No. 3, The Eyes of certain Pulmonate Gasteropods, etc. By Grant Smith. Vol. xlix. The Origin and Structure of the Roxbury Conglomerate. G. R. Mansfield. Vol. l. No. 1, Structure and Relations of Mylostoma. By C. R. Eastman. No. 2, Fossil Hymenoptera from Florissant, Colorado. By T. D. A. Cockerill. No. 3, Madreporaria (Agassiz Expedition). By T. Wayland Vaughan. No. 4, Sharks' Teeth and Cetacean Bones. C. R. Eastman. No. 5, Vertebrata from Yucatan. No. 6, New Species of Dinoflagellates. C. A. Kofoid. No. 7, Mylostomid Dentition. C. R. Eastman. No. 8, Preliminary Report of Echini, collected among Hawaiian Islands, etc. Agassiz and Clark. Annual Report of Curator for 1905—06.

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Presented by Mr. G. F. Burton, F.Z.S.

ADDRESS.

Read by the President, MR. CHARLES A. HAMOND, *to the Members of the Norfolk and Norwich Naturalists' Society, at their Thirty-eighth Annual Meeting, held at the Norwich Castle-Museum, March 26th*, 1907.

LADIES AND GENTLEMEN—During the past year the Society has continued to increase the roll of members, though, unfortunately, we have to deplore the deaths of Mr. C. L. Buxton, Dr. C. R. Whitty, Mr. W. H. Hackblock, Mr. E. K. Harvey, and Mr. Charles Foster.

The late Mr. C. L. Buxton took great interest in Natural History and Archæology, and had extended hospitality on more than one occasion to the members of this Society.

Dr. C. R. Whitty of Hunstanton had devoted considerable attention to Ornithology, and had made a collection of most of the species occurring on the North Norfolk coast, many of which were stuffed and set up by himself. He also made a collection of works dealing with Natural History.

Five members have resigned, the present total number standing at 283. We have not yet been able to reap the benefit of the alterations in the Laws made at the adjourned Annual Meeting, on 24th April, 1906, by which the yearly subscription will be raised to 6s., commencing from the date of this meeting. With regard to the increased amount of composition for Life-membership, we have already gained the sum of £3, as two new members, Mr. Philip Hamond and Mr. C. S. Cockburn, have become Life-members since the Law was altered, and Mr. Gurney, though an older Life-member, has, very generously, subscribed an extra £1.

Our thanks are due to Rev. E. N. Bloomfield for paying the expenses of printing his paper on "Suffolk Fungi," to Miss Geldart for presenting the plate to illustrate her paper on "*Stratiotes aloides*," and to Mr. Patterson and the proprietors of the 'Daily Graphic' for a plate of the Norwegian Lobster, also, to Mr. Brittain for various lantern exhibitions.

Our library has been increased by donations of books and papers by Mr. J. H. Gurney, Mr. G. F. Buxton, Mr. H. G. Barclay, Mr. T. Southwell, Mr. H. B. Woodward, Mr. A. Bennett, Mr. J. Edwards, Rev. E. N. Bloomfield, and Mr. A. Mayfield.

The attendance at the evening meetings has been quite up to the average.

On 29th May, 1906, Mr. J. H. Gurney, F.Z.S., announced that he had succeeded in breeding the Jackal Buzzard at Keswick for, he believed, the first time in England. A paper on "A Personal Study of the Geology of Niagara," by Dr. James Lindsay, F.G.S., was read, also a note on "Woad," by Mr. A. Bennett, F.L.S.

On 14th June, by kind invitation of Lord Walsingham, the members of the Society, in conjunction with the Norwich Science Gossip Club, made an excursion to Merton Hall, where his lordship's fine collection of Lepidoptera were shown. A large number of members responded to the invitation, and a most interesting day was spent.

Mr. F. Balfour Browne acted as our Delegate to the meeting of the British Association at York in August.

The subjects discussed at the Conference of Delegates included

(*a*) Local Societies and Meteorology.

(*b*) The desirability of Promoting County Photographic Surveys.

The first subject was introduced by Dr. Hugh Robert Mill. He alluded to various definite researches which should be

carried on in specific direction, such as, the investigation of the free air at great heights by means of instruments raised by kites, the study of local climate, additional observations on rainfall, etc.

Mr. W. Jerome Harrison, F.G.S., gave an account of the Origin, Progress, and Objects of Photo-Survey Work, and spoke of the value of such a survey to the generation by which it is executed and to all succeeding generations, and of the importance of preserving records of the physical features of the land, as well as of the buildings and monuments. It was pointed out that we should record, also, the life of the nation, including the trades, dress, occupations, habits and amusements. The Ethnographical Survey of the United Kingdom was being hastened by the British Association, as, if not completed soon, the amalgamations of the different counties will have gone so far as to render the task useless, if not impossible.

Prof. H. H. Turner suggested that local Societies desirous of undertaking new work might profitably consider (*a*) Observations of Solar radiation, (*b*) Observations of the brightness of the sky at night.

25th September, Mr. A. Patterson read a paper on "Spring and Summer Yarmouth Notes." Mr. T. Southwell exhibited a specimen of *Scomber thunnina*, Cuv., a fish new to Britain, and Mr. P. R. Rumbelow a Pygmy Shrew. Mr. J. T. Hotblack showed photographs and drawings of the Excavations of the Castle-Mound, giving an account of what is known of the history of the Mound.

30th October, Mr. F. Balfour Browne read a paper on "The Natural History of some British Fishes," illustrated by lantern slides. Two papers were contributed by Mr. A. Bennett, viz., "*Liparis loeselii*, Rich: an extension of Range," and "*Silene otites*, *Artemisia campestris*, and *Chenopodium botryodes*, in East Anglia." Dr. Plowright sent an account of the Chrysanthemum fungus, discovered

by him at Lynn, and Mr. J. H. Gurney read a paper on "The Southern Grey Shrike."

27th November, Mr. Henry Laver, F.S.A., sent a note recording the discovery, amongst the rubbish of a Roman villa recently excavated at Grimston, of Shells of the Apple Snail (*Helix pomatia*), and a paper on "The Poison of the Weever-fish" by Dr. H. Muir Evans was read. Mr. J. O. Borley, M.A., described the poison-apparatus of the Weever-fish.

27th January, 1907, Mr. T. Southwell, F.Z.S., contributed a paper on "Some Old-Time Norfolk Botanists." Mr. W. G. Clarke read "Notes on the Natural History of the Thetford District," and a paper on "The Distribution of Flint and Bronze Implements in Norfolk." A series of fifteen lantern slides were shown on the screen, illustrating the nesting habits of the Great Crested Grebe and the Coot. The photographs were taken by Miss E. L. Turner, and were so much admired, that two or three members, including Mr. Gurney, Mr. J. H. Gurney, and Mr. Southwell, have offered to subscribe towards the reproduction of several of them in the forth-coming part of the Transactions. Dr. S. H. Long exhibited some interesting specimens of the Black Rat, and read some "Winter and Wild Bird Notes" made by Mr. A. Patterson. Your President brought to the meeting a core of Flint, from Sennowe, with the flakes which had been regularly chipped off, all round, and Mr. Colman sent specimens of Neolithic implements found at Crown Point.

On February 26th, Mr. F. C. Hinde made some remarks on the objects of the recently-formed Museum Society. Mr. F. Balfour Browne read a paper on "The Life-history of the Dragon-Fly," illustrated by lantern slides. Papers on "The Crustacea of East Norfolk Rivers," by Mr. Robert Gurney, and "Meteorological Notes for 1906," by Mr. A. W. Preston, F.R.Met. S., were brought before the meeting. A few remarks were made on the loss the Society would sustain by

the departure of Mr. F. Balfour Browne from Sutton to Belfast.

In accordance with custom, it falls to my lot this evening to say a few words upon some subject of Natural History that I have taken a particular interest in, and I take

NOTES ON BLAKENEY HARBOUR PAST AND PRESENT.

I avoid as far as possible trespassing on the ground of my Archæological friends, and keep to the changes wrought by wind and tide on this part of the coast. When one considers the subject of coastal loss or gain there is not much difficulty about the seaboard between Weybourne and Yarmouth haven; the land which has been lost there has been valuable; churches and villages have disappeared into the sea, and in consequence the rate of loss has been fairly accurately measured, at all events for the last 300 or 400 years. But when we come to the coast to the westward of Weybourne, we find a set of totally different conditions. The land encroached upon by the Salthouse shingle beach was not of great value, and it seems that this encroachment has gradually diminished as one goes west. I think, with Bloomfield, that Blakeney and Sniterley were one and the same town; in my earliest map (1586) it is called "Blakeney also Sniterley."

I show a chart of this part of the North Sea from the Admiralty Survey on the scale of three inches to the geographical mile, the dark part being that which is dry at low water, the lighter shade anything under three fathoms low water, and the dotted line the five fathom line: the general character of the shoal being a ridge of sand rising forty or fifty feet from the bed of the Wash, and sloping gradually to the eastward.

I would here draw attention to the set of the tides on this part of the Norfolk coast; the stream of flood tide which

comes from the north, is divided into two by this shoal, one stream flowing to the Wash, and the other being deflected by the banks, and constantly adding to them with detritus from the Yorkshire cliffs. The apex of the triangle, *i.e.*, the Docking Shoal, continually grows out to the northward (North Sea Pilot). This latter stream takes a south-easterly course and strikes the land in the neighbourhood of Salthouse and Weybourne, thence following the coast line in the ordinary way. The effect of this triangle of shoal has been to protect the coast from Hunstanton to Weybourne, both from heavy seas and strong tidal currents; further, a somewhat complex tidal current sets during part of the ebb out of the Wash through Brancaster Bay, laden with fine mud from the great Fen rivers, which is deposited by the ensuing high water on the Great Meal Marsh, a level of rich alluvial soil, ten to fifteen feet thick, overlying sand and gravel; the amount of mud deposited this way must be immense; after a high tide has left the marsh, every leaf of Wormwood and Sea Blite, and every blade of grass shows a grey deposit of fine mud. The tidal marsh which extended to Glandford Mill was banked at Cley in 1824, and sluices were built; the tidal marsh close to Cley has since that time been raised by this deposit some five or six feet above the level of this old tidal marsh within the wall, and is now only covered by shallow water at the height of Spring tides. A definite law which affects tidal districts is that in proportion as tidal marshes are reclaimed and the area covered by the tide diminished, so more and more marsh offers itself for reclamation, and the port by which the tide enters becomes for lack of scouring more choked up.

I now come to a consideration of Blakeney Harbour; there are few corners of Norfolk which afford such opportunities to the true lover of Nature. Every Norfolk Naturalist who follows the pursuit of Botany or Geology, or has studied his Stevenson with the admirable notes on Blakeney by Mr.

J. H. Gurney, Mr. Southwell, and the late Rev. E. W. Dowell, must have a strong feeling of interest in this district. The Proceedings of our Society contain yearly notes of the various migratory birds, rare fishes and plants, and occasional sea mammals which have occurred here.

I well remember the joy of a schoolboy whose knowledge of the coast had been confined to the comparatively dull beaches of Cromer and Overstrand at his first visit to this estuary, where endless varieties of unknown birds fed and whistled around him, where Eels, Sand Smoulds and Flat Fish were to be netted or speared, and where a knowledge of boat sailing could be acquired without the distressing accompaniments of open water. Perhaps one of Blakeney's greatest charms to the inhabitant of "the enclosed District" is the escape from the confinement of hedgerows and gates, and the wide view of brown muds, yellow sands and blue water. Attractive as the Harbour is to the ornithologist when hard frosts have driven the wild fowl from inland waters, and when winter gales compel them to seek refuge from breaking seas outside the bar, he will find a visit during the nesting season well worth his while, and will enjoy the sight of Common and Lesser Terns, Shell Ducks, Oyster Catchers, Ring Plover, and Redshanks freely nesting, and perhaps may have the treat of marking the most graceful flight and strange cry of an occasional Roseate Tern: but he will find the time of autumn migration the most interesting, from early August, when the first flight of Waders arrives from the tundras, throughout the rush of migrants of many kinds to the marrams during September on to the dropping in of Woodcock, Snipe and Duck in October and November.

The botanist may find such common Grasses as *Spartina stricta*, *Aira canescens*, *Lepturus incurvatus* and near the ruined Blakeney Chapel *Kocleria cristata*, a grass that I once met with in a very different geographical situation, 8,000 feet above sea level, in New Mexico, though on an equally dry

and barren soil. The Flora has a beauty and character of its own most attractive to the inland botanist.

The Geologist may note, laid bare, such a mixture of soils as is to be found on many a Norfolk farm, varying from the stiffest clay through all gradations of sandy or gravelly loam to blowing sands or long ridges of shingle, and may find in sheltered corners that wind and tide have deposited layers of Cockle and Clam Shells, reminding him of the Weybourne Crag.

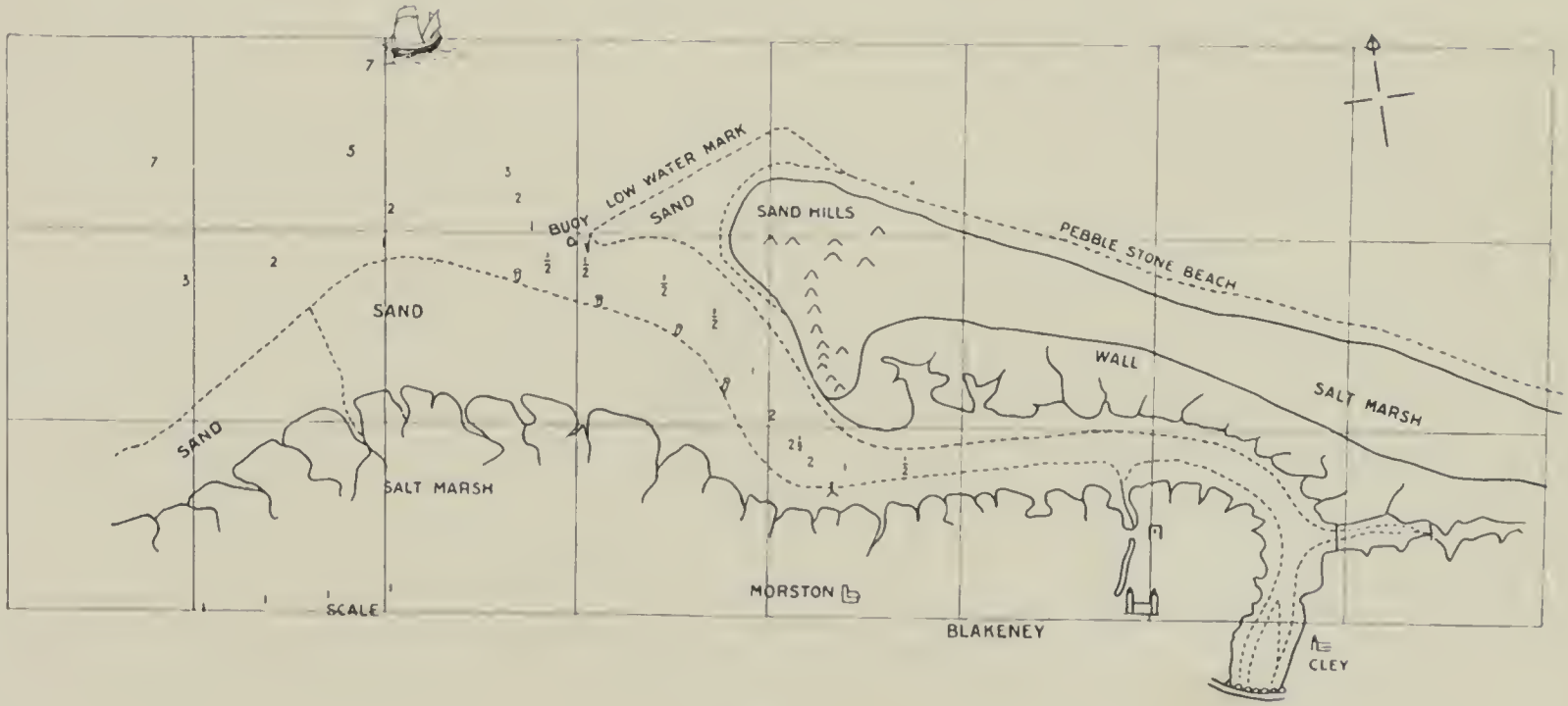
The maps which I show are done on the scale of eight inches to the mile.

The first belongs to Mr. Bolding Monement (date 1586); the original is as much a picture as a map, and distances and positions are very uncertain; for instance, the relative positions of Cley, Blakeney, and Morston Churches. I have assumed the two latter to be in their right places—from Blakeney Church to the mouth of the Stiffkey river is three miles, about the distance that the Harbour mouth is now. Blakeney Church to the Harbour mouth is here just two miles, showing the entrance to be east of the present sandhills, and just west of the high sandhill known as Blakeney Hood. The second is Grenville Collins' plan of Blakeney harbour (date 1690). Charles II., whose care for his navy was one of his best traits, gave instructions that, as no English charts existed and Englishmen were, and always had been, dependent on Dutch charts, Captain Collins should have the use of a large yacht to execute surveys, which, says he, he did in seven years' hard work. This book of surveys was lent me by Mr. Genochio, the head officer of the Lynn Custom House.

This chart gives the low water mark of the beach due north of Blakeney Church as 550 yards further seaward than the Ordnance Maps of 1890, the sands due north of Morston, 330 yards further, and the furthest spit of sand as 400 yards further. If, as is asserted by Wheeler, in the 'Sea Coast,' the rate of encroachment between Cromer and Mundesley

MAP I

BRITISH MUSEUM
NATURAL HISTORY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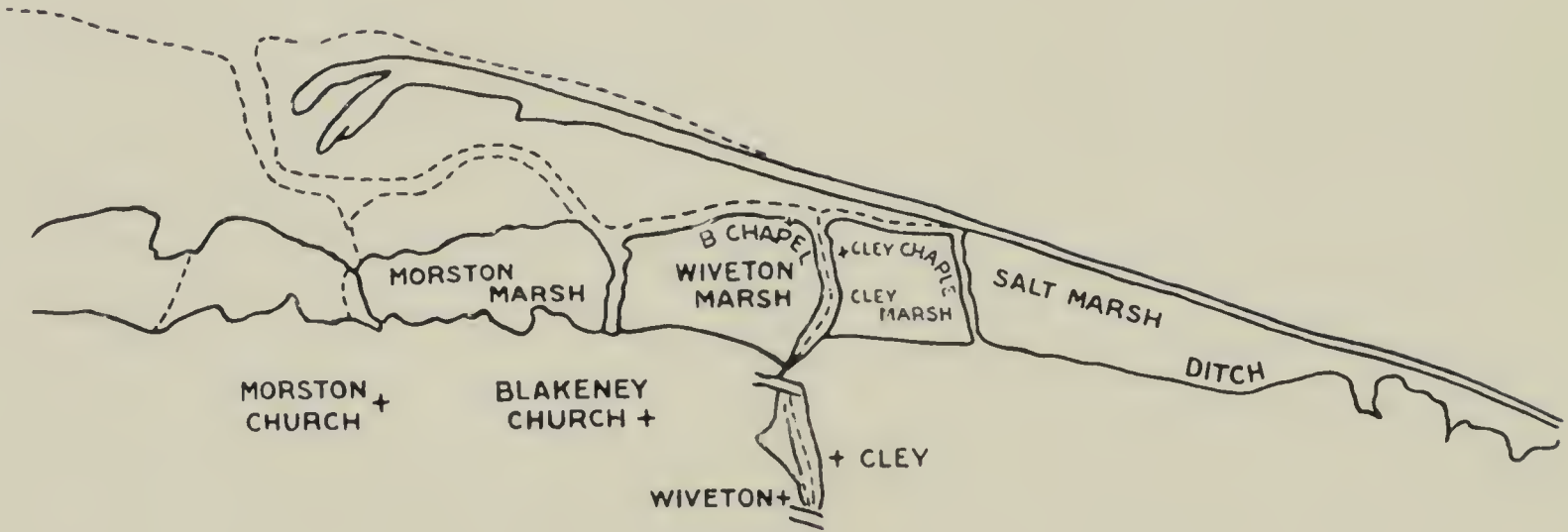
BLAKENEY
CLEY

MAP II

BRITISH MUSEUM
NATURAL HISTORY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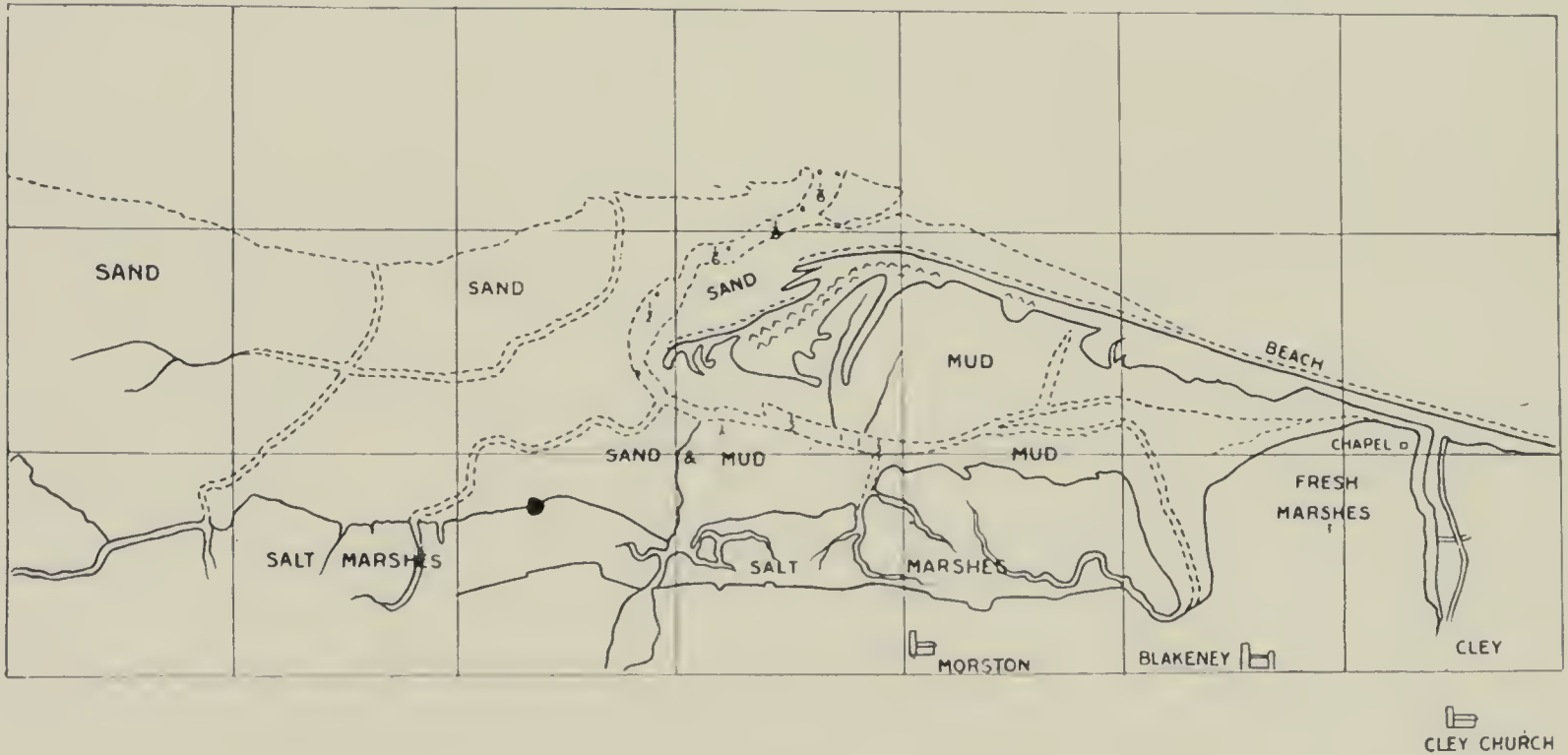
MAP III.

BRITISH MUSEUM
NATURAL HISTORY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FRESH
MARSHES
SALT MARSHES
SALT
MARSHES
MORSTON
BLAKENEY
CLEY
CLEY CHURCH

MAP IV

BRITISH MUSEUM
NATURAL HISTORY

has been since 1838 at the rate of fourteen feet per annum, that would be more than double the rate of encroachment at the Blakeney entrance.

The Harbour which also gave access to Salthouse had a fine deep anchorage in it in those days of two and two-and-a-half fathoms at low water, where we now have to put up with four to six feet. It must, however, have been much exposed to N.W. winds, as the point had not formed the long spit which now protects the anchorage.

The third map is Donald and Milnes of 1797; it is the first map, as distinguished from a chart I have met with, that was done from an actual survey; this map gives the beach due north of Blakeney Church as 330 yards further seaward than 1890; but due north of Morston the sands are at the same distances as to-day, and the actual entrance almost as now, but the point has grown out in a S.W. direction exactly three-quarters of a mile in the last 100 years. The tremendous N.W. gale of December 29th, 1897, which flooded Cley, Salthouse and Wiveton, swept this ridge of shingle nearly flat, and although it has grown up again to a certain extent, it does not afford nearly the same protection to the harbour and banks enclosing the marshes as it did.

The last map is from the latest Ordnance Survey, and shows a Harbour gradually silting up from the causes I have alluded to, but still a happy hunting-ground to the Norfolk Naturalist.

I.

NORWICH CASTLE MOUND.

By J. T. Hotblack, F.G.S.

Read 25th September, 1906.

The history of the Castle Mound at Norwich has for a long time been very much discussed. There has been considerable difference of opinion as to when it was raised. Is it a pre-Roman work, or did the Saxons raise it and place one of their wooden stockades on the top of it? Or is it no older than the Norman Keep which even now crowns it? I do not think that its age has been at all satisfactorily disposed of, and I am very loth to agree with some recent opinions which would make it no older than the Normans. One argument used against the Norman theory has been that it could not have consolidated sufficiently, if they raised it, to carry the weight of their very heavy stone Castle. But then the question arises: To what extent is it an artificially raised Mound? I think the general opinion has been that it was entirely artificial, and this view seemed to be confirmed by the report made as to the sinking of a bore-hole inside the Keep at the time of its conversion into a Museum Gallery, which was said to have been taken down to the level of the present bottom of the Moat, through made soil all the way, undisturbed black alluvial being found, if I remember rightly, at the bottom of all. Now by the ever to be lamented work of the County in preparing for their new monstrosity, we know that, at all events on the side next the Shirehall, the whole of the mound is not artificial, but that those raising it, whoever they were, took advantage of a natural hill or cliff, which they found ready to their hand, and only added to it to make their mound. I have had photographs taken, and myself made sketches

BRITISH MUSEUM
NATURAL HISTORY

EXCAVATION OF CASTLE-MOUND.

(Photograph taken 15th August, 1900.)

during the progress of the recent cutting away of the hill, and these plainly show that for some feet above the present ground level there is sand and gravel which has never been disturbed since it was deposited in some comparatively remote geological period. The height of this undisturbed ground was found by comparing the sketches taken at different times, to rise as the mound was entered, and it may be reasonably expected that further into the mound the natural ground would be found higher still. The builders have not been content with cutting away the face of the mound, but they have gone down some ten feet deeper than the ground level, and this cutting shows the undisturbed chalk, with many large flints, but just below the ground level; and, again, I should not be surprised if the undisturbed chalk itself rises higher further into the mound. On the other hand trial holes sunk only a few feet from the base of the mound show 20 feet of black soil, and even at 20 feet they have not reached the bottom of it.

The accompanying photograph taken a day or two before the cutting away was completed, shows by the ladder of 30 staves, 9 inches apart, that the depth of the cutting was then about 20 feet; but when I last saw it, just before the concrete wall was commenced, the same ladder hardly reached the top, so that the cutting would then be at least 23 feet. Of this, on an average, quite 12 feet was undisturbed sand and gravel; in one place it might be as high as 15 feet, and in another as low as 9 feet; above this came an average of 8 feet of black soil, this again varied a good deal, being thicker where the sand and gravel were low, and thin where they were high; above this came a very level band of about two feet of white chalk, and above that again about one foot of black soil. It looks as though the excavators of the ditch first threw the black soil from the surface on to the top of the cliff, then when they came to the chalk in the bottom of the ditch, that was thrown on the top of the black soil, so that the hill when first raised would be as it were encased in chalk. The thin layer of black soil on the top of the chalk I take to have been formed there since the mound was raised.

One word more as to the unwisdom of these operations.

Norwich Castle on its pre-historic mound is one of the irreplaceable treasures of County and City alike. The Castle was, I believe, used by the County (as well as by the City) as an heraldic device until recently replaced by the present ridiculous combination which makes up a shield, the meaning of which I have found no one to understand. Nothing should have been done either by cutting away the mound to endanger the buildings on its summit—(there are already ugly cracks in the castellated wall near the present Shirehall)—or by erecting fresh buildings to hinder the view of the Castle from below or that of the City and the country round from the top of the mound. I venture to predict that the present County authorities will in the future be as generally condemned for the erection of these buildings, as are now their predecessors for the money they worse than threw away on the re-facing of the Keep.

II.

LIPARIS LŒSELII, RICH., AN EXTENSION OF RANGE.

By A. Bennett, F.L.S.

Read 30th October, 1906.

The claim of East Anglia to possess the only habitats in Britain for the above species is no longer tenable.

Much to the surprise of students of the distribution of our Flora, the Rev. H. J. Riddelsdell recorded* his finding of the plant ("many hundreds of specimens") in Glamorgan, but withholding the locality.

* 'Journal of Botany,' 274, 1905.

In subsequent letters to myself he describes the locality, giving the species it was associated with (many of these he left out in his record, as it would have too definitely indicated the place), and the nature of the ground. In May, 1906, my correspondent, Mr. H. H. Knight, wrote me it had been found in Carmarthen, giving the finder's name, Mr. Barker. Mr. Barker most kindly sent me a full description of the place and the principal plants occurring there, with a tracing of two of the specimens gathered in 1898. The tracing at once showed that the specimens were similar to the Glamorgan ones; differing from our East Anglian in being smaller with shorter and broader leaves, and of course less number of flowers, in all these agreeing well with those of the Friesian Islands, whence I have specimens sent me by Drs. Buchenan and Focke of Bremen.

And the place of growth is just what is given in the Dutch and German Floras of these islands. It has been generally supposed among British botanists that *Liparis* was epiphytic upon Sphagnum, but Mr. Fryer sending to Mr. Ridley,* many specimens of our native species, speaks of finding it growing directly on clay, though rarely. Since then he has found it on peat. "One specimen I got was a foot high, rooted in black peat, but I think the Sphagnum had decayed because the spot was too long overflowed in winter."†

And I have seen it near Thurne, away from the moss. In Carmarthen and Glamorgan no *Peucedanum palustre* or *Lathyrus palustris* occurred with the *Liparis*, but they do so in the Friesian Islands, and they are generally not far off in East Anglia.

Mr. Riddelsdell remarks, "The sandy bottom just at the spot is remarkably spongy, and resilient to the foot, not so elsewhere in the hollow."

In the Friesian Islands it occurs with *Pyrola rotundifolia*, and *minor v. arenaria*, *Parnassia*, *Carex trinervis*, *Goodenovii*, *acuta* and *Oederi*, *Hierochloe borealis*, *Erythræa pulchella*, and

* 'Monograph of Liparis.' Jour. Linn. Soc. xxii. 244–297. 1887.

† Letter, 20th July, 1885.

Juncus atricapillus.* It occurs in Texel and Schierm (Dutch), and Borkum, Juist, Norderney, and Langeroog (German) Isles.

In Canada it occurs "on logs in a swamp, Oak Hills, Ontario," and "on logs in a swamp near Campbellford, Ontario."†

There is a good list of plants occurring in Wicken Fen, Camb., where *Liparis* still occurs, in Babington's Fl. of Camb. also copied into 'Fenland, Past and Present,' 303, 1878.

The extraordinary way in which this plant has occurred of late years is markedly different to former times. By the kindness of Mr. Southwell, Miss Geldart has sent me an extract from a letter of Mr. W. L. Notcutt's, 5 June, 1854. "As for *Liparis læselii*, I wish you may get it, and so do loads of botanists; I would send it if I could but I can't and in all human probability never will it be in my power." Having seen it by hundreds at Ranworth and Chippenham, Cambs., the letter reads curious enough now. Its occurrence or disappearance could well be watched at Chippenham, but the owner dislikes the ground gone over, and especially dislikes the incursions of Entomologists, though it is one of the richest places in E. Anglia.

The growth of *Liparis* is most interesting. Crepin, who gives a detailed account of it, does not mention any insect or animal that preys on it; but in E. Anglia the older pseudobulbs are often eaten at the base. It can hardly be natural decay, as the edges, &c., are too regular; but I have never been able to trace anything preying on it—do our Entomologists know of anything that does?

At present there seems no explanation of this extension of its distribution, unless as suggested by Miss Geldart, that in Neolithic times *Naias marina* (found in Glamorgan deposits‡) was the companion of the *Liparis*. Another surprising discovery in Glamorgan is *Sesleria cærulea*, and there is no doubt that Wales will well repay further exploring for plants.

* Fl. Ostfries, 40, 1849.

† Macoun. Cat. Canad., pl. iv. p. 3, 1888.

‡ C. Reid. 'Origin of British Flora,' p. 159, 1899.

KIDWALLY, CARMARTHENSHIRE.

"*Liparis* was associated in the damp hollows of the sand-hills with the following species, some growing with and some above on slightly higher ground :—

LOTUS CORNICULATUS, L.	EUPHRASIA OFFICINALIS, L.
POLYGALA SERPYLLACEA.	ANAGALLIS TENELLA, L.
POTENTILLA ANSERINA, L.	ORCHIS INCARNATA, L
LINUM CATHARTICUM, L.	EPIPACTIS PALUSTRIS.
HYDROCOTYLE VULGARIS, L.	CAREX GLAUCA, Scop.
BLACKSTONIA PERFOLIATA.	,, ARENARIA, L.
MENTHA AQUATICA, L.	,, GOODENOVII, Gay.

OPHIOGLOSSUM VULGATUM, L.

SALIX REPENS, L. v. PARVIFOLIA.

"Growing about a quarter of a mile from the sea, some twenty specimens seen, growing in three separate depressions. Had I had time I have no doubt I should have found more." H. H. KNIGHT *in litt.*

III.

SILENE OTITES, *ARTEMISIA CAMPESTRIS*, AND *CHENOPODIUM BOTRYODES* IN EAST ANGLIA.

BY ARTHUR BENNETT, F.L.S.

Read 30th October, 1906.

THIS paper endeavours to give the distribution, first records, &c., of these species and to trace them on to later dates, and thus to bring together information to help in some future historical account of our Flora.

The two rare species (*Silene* and *Artemisia*) of the "Breck" region of Suffolk and Norfolk must have been more abundant in former times, especially before the large area of ground broken up and ploughed some years ago, when farming was in a very prosperous state, and of which much has gone back to a semi-natural state. Mr. C. S. Read observes,* "It becomes every year more patent that a large extent of sandy soil in S. Norfolk should never have been ploughed, but have been allowed to remain in its original sheep-walk or rabbit warren. The mistake is hard to rectify. These blowing sands are extremely difficult to turf over with any kind of grass, and they will be many years before they will produce the hard, coarse herbage which formerly fed so many sheep and rabbits."

These deep-rooted perennials would suffer severely, while annuals would survive and flourish.

The *Silene* still occurs in some abundance between Elden and Icklingham, but in most of its other Suffolk stations it is much more uncommon than formerly. It may still do so in W. Norfolk, but I have not visited its localities there.

The *Artemisia* is certainly less plentiful between Thetford and Elden since 1876, yet there is no apparent reason why; the road is "better kept" perhaps. And it produces so many stems from one root (I saw one root between Barnham and Culford with 32 stems) that collectors can easily satisfy themselves. Both possess strong tap-roots, and root deeply, so can stand drought, and rough usage above ground; but I do not think seedlings can grow so freely as formerly, as the grass seems coarser and thicker than it used to be.

In my garden the *Artemisia* produced seedlings in abundance

The *Silene* I noticed in some years was considerably "smutted" by a fungus, *Ustilago artheranum*, Fries.

Silene Otites, Smith, Fl. Brit., ii., 469, 1800.

Silene parviflora, Gray, Nat. Ar. Br. Plants, 647, 1821.

Cucubulas Otites, L. Sp. Pl., i. 415, 1753.

Sesmoides Salamanticum Magnum, Gerarde, Hist. Pl. (Johnson), 493, 1633.

* In White's 'Gazeteer and Directory of Norfolk,' p. 71, 1883.

Lychnis viscosa flore muscoso, Raii, Syn., 340, 1724.

Spanish Campion, Huds., Fl. Angl., 186, 1778.

Small-flowered Catchfly, Gray, *l.c.*

Spanish Catchfly, Syme, Eng. Bot.. ii., 64, 1864.

*First Record. "*Otites Tabern. sive sesmoides parv. Muscipula salamantica minor.*"

Found on Newmarket Heath, Mr. Sare.

How. Phyt. Brit. 86, 1650.

Eng. Botany, t. 85, Feby. 1st, 1793. "Wm, Matthews, Esq., Bury (St. Edmunds)." †

Suffolk W. Co. 26.

Fornham St. Martin, Risby, &c. Sir T. G. Cullum in Bot. Guide, 551, 1805.

Heath W. of Icklingham Church. Sir J. Cullum, 1771 ! About Thetford in this county ! C. Forster, Junr. Bot. Guide, *l.c.*

West Stow, Icklingham, and Risby Heaths (Mr. Jordan, 1880) ; Tuddenham Churchyard ! Mildenhall. Dr. Jermyn, 1835. Herb. Geldart, Cross, 1879. Between Barton Mills and Tuddenham, 1901 ; abundant near Lakenheath Windmill (July, 1876) ; roadsides near Wether Heath, and between Elden and Icklingham. Oct. 1876.‡ A. Bennett.

Near Redneck Farm, Duke's Drive near Barnham St. Gregory, and dry heath between Mildenhall and Eriswell. C. C. Babington.

Euston, Mrs. French. Rushford Heath, herb. French ; Culford Heath, Gray ; Brandon, Norgate ; Gravel pit at Worlington, Miss Bullenden. ; Cavenham Heath (Jordan sp., 1875) all Fl. Suffolk. 74. 1889.

Norfolk E. V. Co. 27.

St. Faiths near Norwich. Aug. 15, 1855. July 28, 1859. W. Winter, Phyt. 292, 1861. It is possible the Rev. K. Trimmer's record of Eccles may just come within this division, but not certainly so. it is, however, very close to its borders.

* Clarke, First Records of Brit. Fl. Pl., 22, 1900.

† Garry, Notes on Drawings, Eng. Bot. Supp. of J. Bot. 31, 1903.

‡ A very dry summer with copious rains in September, caused many plants to flower a second time, Otites was in all states of flower and fruit.

Norfolk W. V. Co. 28.

Near Narford in the way to Narboro', and the whole way in the lane from Narford, as well as both sides of the Swaffham road by Sir H. Peyton's house. Fl. Ang. Crowe in Hudson's Flora on margin cir. 1780. Narborough, 1845. Wardale sp.

Between Swaffham and Narford on the grassy edges of the road; Woodward Bot. Guide, 432, 1805.

At Barton Bendish on the Swaffham road; Rev. R. Forby, *l.c.*

A little way out of Thetford on the way to Norwich. D. Turner, *l.c.*

Thetford: E. F. Linton, 1886. Brandon on the way to Hillborough; T. Martyn before 1825. Hillborough; Rev. E. W. Dowell. Cranwich; Trimmer, Fl. Norf. 22. 1866. Ickburgh, Eccles; Trimmer supp. 14, 1884. Croxton and Brettenham. Rev. H. Williams.

Cambridge Co. 29.

Chippenham on the balks* plentifully. Relhan, Fl. Camb. 175. 1820.

Plentiful at the Chippenham gravel pits, 1894–6, and close to the county boundary between Fordham and Freckenham. 1896. W. West, Junr. J. of Botany, 250, 1898.

Essex N. V. Co. 19.

Roman wall at Colchester; R. A. Pryor. J. of Botany. 344, 1880. Top of the walls of Colchester Castle (about ½ mile from the last station); W. Whitwell. J. of Botany, 56, 1887. A. Crosfield, sp.

"Was introduced by local lepidopterists as food for their caterpillars." J. C. Shenstone, Essex Nat., 24, 1887.

Reported also from Cardigan, Durham (ballast), N. E. Yorkshire Sp. in Middleton herbarium. Baker, North Yorkshire, 268, 1889.

Distribution :—

Denmark, Holland, Germany, France, Switzerland, Italy, Austria, Russia, Siberia, Persia, Turcomania.

* Slender lines of ancient turf used to divide the fields, and the native flora long remained on them after it had become extinct in other places. Fl. of Cambridge, p. xv., 1860.

ARTEMISIA CAMPESTRIS, Linn., Sp. pl. 846. 1753.
ABROTANUM CAMPESTRE, Raii, Syn. 190. 1724.
WILD SOUTHERNWOOD. Petiver. H. Brit. t. 20, *f.* 4. 1713.
FIELD WORMWOOD. Hudson, Fl. Angl. 358. 1798.
,, MUGWORT. Gray, Nat. Ar. Br. Pl. 449, 1821.
,, SOUTHERNWOOD. Smith. Fl. Brit. 2. 863, 1800.
First Record.*

Abrotanum campestre on Newmarket Heath. Mr. Sare. How. Phyt. Brit. 1, 1650.

" At a place called Elden in Norfolk (*sic*). 12 miles beyond Newmarket in the way towards Lynn." H. Willisel. Ray. Cat. Pl. Angl. 2, 1670.

English Botany t. 338. Aug. 1, 1796. " Dr. Smith and Sir Thos Cullum : Icklingham Heath, 8 miles from Bury ; went to Elden, the habitat of Ray, where Mr. Hud[so]n, and S. T(aylor) found it a few years ago in profusion, but could not meet with a plant this time." †

This figure is not at all good for the English plant, the segments of the leaves are too wide for any form of it, or even for the cultivated plants for two stations. In fact the figure is much more like the var. *maritima* (*A. crithmifolia*, Dl.) than our specimens ; yet it was drawn from the Icklingham specimens.

It occurs in Suffolk in two forms, and I believe that from Icklingham plains to be the var. *longifolia*. Wallroth. Sched. Crit. 457, 1822.

These forms can be distinguished as easily in winter (when cultivated) as in summer ; *longifolius* has the leaf-segments longer, more compacted, more shining, and the habit is more graceful, and frost is more abundant on it than on the other form.

SUFFOLK W. Co. 26. 1670.

At a place called Elden in Suffolk, 12 miles beyond Newmarket, towards Lynne, on the balks‡ of cornfields, and by the waysides abundantly, for a mile in length and breadth ;

* Clarke, *l.c.* 76.

† Garry, Notes on the Drawings for Eng. Botany, J. Botany, Supp. 101, 1903.

‡ See *ante* p. 345.

also a mile from Barton Mills on the way to Lynne, and among the furze bushes under the hill. Ray, *l.c.*

Icklingham Heath near Bury. Sir J. G. Cullum in York Phil. Soc. Herb. !

Brandon. B. D. Wardale, 1845, sp.

Thetford Heath; Rev. G. R. Leathes in herb. Wilson. Barnham, Lakenheath and Eriswell. Hind, Fl. Suff., 205, 1889.

Barton Mills; Herb. Buddle before 1715. I could not find it in 1901.

Mildenhall. Sir C. J. Bunbury.

Wangford. Henslow and Skepper, Fl. Suff. 45. 1860. A. Bennett. 1878.

Tuddenham. Herb. Borrer at Kew !

The Nunnery wall, Thetford. Skepper.

Thetford to Elden by roadside. 1876 and 1902. A. Bennett.

Barnham to Culford, 1901. A. Bennett.

By the Duke's ride nr. Barnham St. Gregory. Babington, 5, 10, 1848.*

Between Brandon and Wangford, 1878. A. Bennett.

Between Mildenhall and Eriswell, and again in plenty toward Holywell Row.† Babington in Jour. of Life, 62 and 147, 1897. Icklingham Plains.‡ A. Bennett.

Norfolk E. Co. 27.

? Heaths near Yarmouth, Norfolk. W. Winter, Phyt. 295, 1861, but if found likely in Suffolk, this is not so unlikely, as *Veronica verna* and *V. triphyllos* have been found in E. Suffolk, but the authority is not reliable.

White Top Common near Blickling. K. Trimmer, Fl. Norf. 75, 1866. This is N. of Abel Heath, and I am indebted to Miss Geldart for a tracing (coloured) of the Ordnance Map of 1837, showing its situation.

* 'Journal of Life,' 147, 1897.

† Specimen in herb. C. Bailey.

‡ Marked in Dower's Map as between Mildenhall and Icklingham, about two miles south of the Heath.

Norfolk W. Co. 28.

"About Thetford where it was discovered in Ray's time (c. 1724), and still grows by the side of the great road, about a mile from that town on the way to Norwich." Crowe in Hudson's Fl. Angl. (marginal note) c. 1780. J. Lucas, sp., 1868. H. G. Glasspoole in herb. Geldart, July, 1885.

Devil's Ditch, Cranwich; Miss Rackham, Aug., 1840, in herb. Miss Geldart. The Ditch commences at the river side, Brandon, and terminates at the Fenny district of the Stoke river, near Cranwich.*

Looked for in crossing Santon Warren from Thetford to Brandon, but not seen. Dr. Williams (Prod. Fl. Brit., part 2, 34, 1901) seems to doubt its present occurrence in Norfolk, but gathered in 1885 it can hardly have been exterminated since. It roots very deeply, and seedlings are naturally produced in abundance (at least they are in cultivation). Dr. Williams does not seem to have known of the Cranwich locality.

Cambridge Co. 20. 1650. Extinct.

Newmarket Heath. Mr. Sare, *l.c.* Whether this was actually on the Cambridgeshire part of the Heath, or the part formerly (and now ?) claimed by Suffolk, there is now no means of ascertaining; but the late Rev. W. W. Newbould always contended it was Cambridgeshire.

It has been reported for Surrey (Watson, Out Geog. Dist., 189, 1832).

N. E. York. Moore and Ibbotson.

Durham. Ballast hills.

Dorset. Top. Botany.

Devonshire. R. Jordan.

Belfast. Ireland.

In all these (if found) merely an introduction.

Distribution :—

Finland, Sweden, Denmark, Norway, Belgium, France, Holland, Germany, Switzerland, Italy, Austria, Russia, Siberia, China, Turcomania, Afghanistan, Algeria.

Its nearest locality to England is Holland, where under the form of *A. crithmifolia*, Dec., it occurs among the extensive

* Babington, 'Ancient Cambridgeshire,' 105, 1883.

sand dunes of that country. It covers vast tracts (with other species of the genus) in Middle and South Russia.

The Canadian plant is *A. canadensis*, Michn.

CHENOPODIUM BOTRYODES. Smith, Eng. Bot. v. 32, t. 2247. Feb. 1, 1811.

The specimen figured was sent by Mr. Lilly Wigg from near Yarmouth, Sept., 1808.

"We are obliged to the accurate Mr. (Lilly) Wigg for pointing out this plant to us near Yarmouth." Smith, *l.c.** Its first record as a British plant; but it is probable that Ray's "*Blitum sylvestre, q. blito peo anseriamus dicto similis*" Syn. 154, 4, 1724, refers to this.

Syme in Eng. Botany † makes it a sub-sp. of *C. rubrum*, L.

Hooker and Arnott. Brit. Fl. ed. 6, 362, 1860, make it a variety.

How far the Continental plants referred to Smith's species are so, is difficult to say; Richter‡ gives eleven names under it which he considers the same. Lange in his Hand. Danske Flora. 278, 1887, gives Smith's species, and quotes the Eng. Bot. Plate. He calls it "*Dineblomstret Gaasfod*"—Grape-flowered Goosefoot.

The best account of the plant we have is by Mr. G. Fitt.§ He remarks, "when fresh gathered the smell is like that of the pods of green peas. One fact connected with *C. botryoides* will, I think, be interesting to botanists. It grows in the greatest profusion and beauty (for it is a handsome plant with deep crimson stems) where mud has been thrown out of the ditches during the summer, and where grass has not had time to grow. In proof that the seeds in this case were in the mud, wherever the latter was scattered about the marsh, as it was in several places, there grew *C. botryoides* in profusion." Mr. H. C. Watson writing on Oct. 9, 1878, remarks, "Your specimen has slightly the scent of *C. ambrosoides* which I do not remember to have noticed in the fresh plant; nor is any fragrant scent alluded to by Boswell," &c. At this date (1906) the scent is still perceptible.

* Clarke, *l.c.* 119. † Ed. 3, viii. 21, 1868.

‡ Plant. Europ. ii. 135, 1897. § 'Phytologist,' i. (part 2), 1137, 1844.

Bunch-of-grapes goosefoot. Gray, Nat. Ar. Brit. Pl. 284, 1821.

Many spiked goosefoot. Sm. Eng. Fl. ii. 11, 1828.

Many clustered goosefoot. Syme, Eng. Bot, ed. 3. viii. 21, 1868.

Bunchy goosefoot. Hind. Fl. Suff. 274, 1889.

Distribution :—

Hants. S. Co. 11.

N. coast Hayling Island. Rev. E. S. Marshall, sp.

Sussex W. 13.

Climping. 1901. E. S. Marshall in herb. Salmon.

I saw this in Mr. Marshall's garden at W. Lavington in Sussex, and rather doubted the name.

Kent E. Co. 15.

Pegwell Bay. H. C. Watson! Syme, sp. 1863. A. Bennett, 1878.

Stonar near Sandwich. Syme *fide* Mrs. Benson. Fl. Kent, 294, 1899.

S. Kent. Rev. G. E. Smith to H. C. Watson, 1835.

Kent W. Co. 16.

Gravesend. Syme in Eng. Bot. *l.c.*

Banks of the ditch at the foot of the embankment for a little below Shoremead Fort almost to Cliffe Fort, also on the borders of a marsh under W. Court, a mile from the river." Wolley Dodd sp., 1894.

Port Victoria. W. Dodd and E. S. Marshall.

Essex S. Co. 18.

Canvay Island; S. Shoebury Common; E. Forster. Foulness Island, H. Piggot. Southend, J. Dickson. Gibson. Fl. Essex, 260, 1862.

Essex N. Co. 19.

Mersea Island. E. Forster. Gibson. *l.c.*

25. Suffolk E.

Between the cliff and the sea at Lowestoft.* Sir J. E. Smith.

Plentiful on the Southtown marshes at Yarmouth. G. Fitt to H. G. Glasspoole!

* Garry, *l.c.* 156.

27. Norfolk E.

Near Yarmouth, Sept., 1808. Lilly Wigg.

Chapel Denes, &c., Yarmouth. Paget, N. Hist. 64, 1834.

Growing intermixed with *C. olidum* on waste ground under the old Barracks at Yarmouth, and on the bank of the river near where the whalebones stood. Trimmer, Fl. Norf. 122, 1866.

Haddiscoe, 1880; Winterton, 1881; Bacton, 1870; Halvergate, 1872; Reedham, 1877; Trimmer, Supp. Fl. Norf. 50, 1884.

28. Norfolk W.

Recorded from Hunstanton in 1863 by Prof. Babington, "but the plant found was *C. rubrum*, L. var. *pseudo-botryoides*." H. C. Watson *in litt.* I saw only *rubrum* from Hunstanton and Holme to Thornham in 1876.

Channel Isles.

Lihou, island off Lerée Point in the west of Guernsey. Aug. 14, 1900. C. R. P. Andrews, sp.

IV.

SOUTHERN GREY SHRIKE (*LANIUS MERIDIONALIS*) IN NORFOLK.

By J. H. Gurney, F.Z.S.

Read 30th October, 1906.

Mr. E. M. Connop, whose museum contains probably the largest collection of British killed rarities of any in England, has a Grey Shrike which differs from the ordinary British type in several important particulars. It was shot at Drayton near Norwich, in December, 1890, a month of frost as I see from my journal, and is the same one mentioned at p. 9 of Mr. Southwell's catalogue of the Connop Collection.

On placing this bird, which is marked a male, on the table with ten other British Grey Shrikes, as well as skins of *Lanius*

lathora, *L. algeriensis* and *L. meridionalis*, Tem. (the latter a female from Mr. Howard Saunders' collection labelled "Malaga, 14. II. 73") it appears that it comes nearest to *L. meridionalis*, which is generally known as the Southern Grey Shrike. Its head is much darker than a typical *L. excubitor*'s, and its back is a couple of shades darker. The breast also, which has probably faded, is still slightly suffused with pink. Another point is that the scapulars, which in a typical *L. excubitor* are tipped with white, are in this bird only slightly tipped with grey.

I only find one previous announcement of the Southern Grey Shrike in England, viz., near Colchester, in November, 1875, by Dr. Bree, who records it in 'The Field' of Nov. 13th, 1875, mentioning the dark ash-colour of the back and head, and roseate tint of the under parts, which seem to indicate correct identification, but Mr. M. Christy says the specimen is lost sight of (B. of Essex, p. 105).

Although the home of *L. meridionalis* is Spain and Portugal, it appears to be not uncommon in the South of France, its occasional appearance in England might therefore be predicted. Up to 1895 it had occurred once in Heligoland.

I have taken the opportunity of again examining the Grey Shrike in the Museum which was some time ago provisionally identified as *L. algeriensis* ('Zoologist.' 1899, p. 126), and am confirmed in thinking that it was rightly assigned to that species. It was shot at Ranworth as long ago as February, 1857, and whatever it was then it is now a somewhat dirty specimen. On the whole this bird agrees very well with a male of *L. algeriensis* shot in Algeria in February.

In 'The Ibis' for 1892, pp. 288, 374, will be found a useful key by Mr. H. E. Dresser to *L. excubitor* and its allies, in which he endeavours to point out what are the best marks of distinction between several closely allied Palæarctic species of Shrike.

It is to be expected that among such nearly allied birds hybrids should sometimes occur, and it is possible that Mr. Connop's Shrike is one of these, in which case the parents were no doubt *L. meridionalis* and *L. excubitor*.

V.

HELIX POMATIA, L., AT GRIMSTON.

By Henry Laver, F.S.A.

(Communicated by Mr. T. Southwell, F.Z.S.)

Read 27th November, 1906.

Helix pomatia. The apple snail. The Roman snail. The question whether this snail is a true native of Britain, or whether those found in various parts of the southern counties of England were imported, especially in those districts where remains of Roman camps, towns, or villas occur, is of considerable interest to conchologists in coming to any conclusions on this subject. Popularly in many parts where they are found they are always spoken of as Roman snails, the opinion being, that they are escapes from those introduced by the Romans for use by their cooks. If it be a fact that we owe this snail to the Romans, it is strange we do not find it more frequently in Roman middens, in other than districts where the subsoil is calcareous, for these are the localities where it is generally discovered. However it became a denizen of Britain, it does not now live anywhere excepting in chalky or limestone districts, and even there it is very local. It appears that it is not found in any part of the county of Norfolk at the present time, and the fact of large numbers of the shells of this snail having been found amongst the rubbish and in the middens of the Roman villa, excavated a few days ago at Grimston, must be a matter of interest to the conchologists of Norfolk. In this instance it is a fair presumption, the snail not occurring in the county, that their appearance here is due to the fact that they were imported

by the inhabitants of this villa for food. But as Grimston is on the chalk it is impossible to say that this is an absolute fact. This snail may have been an inhabitant of many districts in England where it is now unknown, and Norfolk may have been one of these localities. Those who have studied the land mollusca of England, must have often remarked the fact, that districts where certain snails must have been fairly common, now know them no more, and the absence of *H. pomatia* from Norfolk may be a case in point. There is one fact in favour of the late introduction of *H. pomatia* into England, and that is the shells of *H. pomatia* are never found in ancient shell marls, although the shells of many other species now living in the south of Europe in districts where *H. pomatia* is found occur.

VI.

OBSERVATIONS ON THE POISONED SPINES OF THE WEEVER FISH, *TRACHINUS DRACO*.

By H. Muir Evans, M.D. Lond.

Read 27th November, 1906.

The painful wounds inflicted by certain fish which are commonly caught by fishermen around our coasts are well known to all who are in any way brought in contact with the men who supply our markets with fish. However, those who most frequently suffer from the pricks from spinous fishes are trawlers, because the Weever is less frequently found in the nets of Herring or Mackerel fishermen. Amateurs are not infrequently stung through ignorance of the dangerous nature of these fish.

There has been comparatively little written by Englishmen on this subject, and those who would read an interesting account of fish with poison organs will find the whole subject treated historically and descriptively by Dr. Bottard in a book published in 1889 entitled, 'Les Poisons Venimeux.'

It is important to bear in mind that the Weever fish is not poisonous, although it has a poison organ, that is to say that the fish is both perfectly good to eat and also has an excellent flavour, yet it has the power of inflicting dangerous wounds by certain spines on its dorsal fin and on either gill cover or operculum.

The following account of the symptoms of a Weever sting is quoted by Bottard :—"I have been pricked several times by *Trachinus vipera*, and I am able to give an exact account of the various phenomena, the result of such an injury.

"The symptoms are almost always the same. They differ only according to the depth of the puncture and the site of the wound; also according to the time of the year and the nature of the spine, whether it be dorsal or opercular.

"In the month of October, 1885, I was pricked fairly deep, in the middle of the palmar aspect of the right thumb. The pain was similar to that of a burn. At the end of only a few seconds all the other fingers as well as that pricked had become immovable and were painfully numb. In two or three minutes the numbness had reached the forearm. The numbness seemed to follow the course of the nerves. The joints were particularly tender. At the end of from five to seven minutes the poison made itself felt on the heart, as shown by somewhat severe palpitation. I then felt cold and shivered. The wounded hand all this time was very painful and tender to the least touch. I was unable to dress it until three quarters of an hour after the accident, when it was impossible to move the arm and I was unable to undress myself alone. Three days after, the surrounding parts were still very painful and the tissues were swollen."

Gressin describes the symptoms as follows :—One experiences at first a very acute pain, lancinating and paralysing, often among nervous persons associated with fainting.

Then a sort of painful tingling attacks the wounded part which swells up and becomes inflamed, and perchance if one neglects to attend to it this goes on to phlegmonous inflammation and gangrene. Frequently certain general symptoms as fever, delirium and bilious vomiting accompany this state. They may last two or three hours or make themselves felt for several days. The fishermen attribute, with some reason, this irregularity in the effects according to the amount of poison inserted or the time of year, the spawning season being most dangerous.

My investigations into the poison organ of *Trachinus draco* were the result of observing the pain and suffering among all associated with the fish trade, both fishermen and packers. I must express my indebtedness in the first place to Mr. Borley of the Marine Biological Association at Lowestoft, who has examined with me the anatomy, both naked eye and microscopic, of the Weever, and has also helped me in getting together the literature of the subject, and in the second place to Professor Sidney Martin, in whose laboratory the experiments into the physiological properties of the venom took place. I must further thank Dr. Stevenson for the great interest he has taken in the subject, and for performing the various inoculation experiments.

The most recent work on the subject of the venom of *Trachinus draco* is to be found in several communications by M. A. Briot in the Comptes Rendus de la Societé de Biologie de Paris (1902–4). The experiments of my own, several years later, were made in complete ignorance of this work, and therefore have the value of being free from any bias. This literature was not referred to in so recent a work as the Cambridge Natural History of 1905.

The methods adopted by Briot in the matter of collecting sufficient poison for investigation differed to some extent from those of Phisalix. The latter macerated the gland in chloroform water and glycerine, and the fluid resulting from this maceration was used in his experiments. Briot took the venomous spines and adjacent tissues, and pounded them in a mortar and made a glycerine extract. He used

the filtered liquid for his researches and for the purpose he used the opercular and dorsal spines of 350 Weevers caught between the end of May and beginning of June, and 70 caught in September.

The method that I employed was, I think, more scientific and accurate. I obtained freshly caught Weevers from a buyer who was in the habit of collecting fish for the Board of Trade, and could be thoroughly trusted. These I washed under a tap, and with pledgets of absorbent gauze wiped any mucus and dirt from their opercular spines. I then laid the fish in rows and again wiped the heads with wool. With a sterilized syringe I extracted from within the sheath, by means of inserting the needle along the groove of the spine, as much poison as possible, obtaining no doubt a certain quantity of cellular elements; but I avoided those heads in which there was postmortem staining of the vascular tissue of the sheath. The fluid thus obtained, say from 100 fish, was collected in a watch glass and placed in a desiccator (Hempel's), the rim being filled with pure sulphuric acid and the air exhausted by means of a pump. In this way, from nearly 2,000 fish, I obtained several grammes of dried Weever poison. This, before making experiments, was finely powdered in a pestle and mortar and dissolved in either distilled water or normal saline solution. These solutions were used either with a certain quantity of solid matter suspended, or filtered, or better, after being centrifugalised, to obtain a resulting clear fluid.

Briot says he was the first to make intravenous injections in the Rabbit. Half a cubic centimeter of his solution caused death so rapidly that he had not time to finish his injection. With .2 or .1 C.C. death was slower, taking several minutes and, according to this observer, it was death by asphyxia. To quote (page 1170) 'Comptes Rendus Soc. Biologie':— In opening the animal immediately after the pupil reflex was abolished, one found that the blood was not coagulated in the portal vein or heart. The heart continued to beat for several minutes and artificial stimuli caused it to contract for some little time. There was no doubt that death was due

to respiratory failure. I was not able to say precisely whether this was due to a direct paralysis of the respiratory muscles, or to an effect on the respiratory centre. But I am inclined to think that it was due to a direct action on the respiratory muscles as much from the rapidity of the death as from the fact that when death did not result in a relatively short time (8 to 10 minutes) it did not occur later.

The local effects of the poison injected subcutaneously have been described by Bottard and Gressin. It produces mortification of the tissues. It appears to produce a local paralysis which is very evident in experiments on fish. If one injects the poison in the region of the lateral line, the fish is sharply bent away from the lesion on account of the predominant action of the lateral muscles of the opposite side. These experiments have been repeated in the laboratory of University College by Dr. Stevenson.

A Gold Fish, *A*., 4 in. in length, died in one hour and a half after injecting .015 grm. dried venom.

Another, *B*., in four hours with the same dose. Seven minutes after injection it lay on its left side, curved away from the site of inoculation which had been made into the muscles of the right lateral line.

Another, *C*., injected with .01 grm. showed the next day some local swelling at site of injection and continued to live until ten days after commencement of experiment. The postmortem showed extravasated areas of blood at site of inoculation and great congestion of peritoneum.

Another, *D*., with .01 grm. died three days after injection, and showed a marked hemorrhagic area along track of needle.

Gold fish, *E*., injected with .005 grm. died eight days after inoculation. There was a soft puffy area with swelling where the injection took place. On incision into this there was a small cavity in the muscles with ill-defined breaking down walls. It seemed as if there was a pure necrosis of muscle. The surrounding area showed bloody engorgement well seen on the peritoneal aspect.

Frog, .015 grm. caused death in 2½ hours, with paralytic symptoms.

Mouse, A., .02 grm. dried venom caused the death of a mouse from a dry necrosis at the site of inoculation in two days. During the day after injection, there was marked paralysis of the hind quarters, the injection having been made under the skin of the back. The large vessels in neck and axilla were engorged and the sinuses of the brain were full.

Mouse, B., injected with .01 grm. dried venom, showed weakness of hind quarters two days after injection, and five days after, a small greenish area appeared on the skin at site of inoculation. The animal died seven days after the injection with similar local symptoms as described in *A.*, but the brain sinuses were not so engorged.

Guinea pig, .05 grm. intraperitoneal injection caused death in three hours. After preliminary pallor and convulsions, the animal became gradually weaker and showed paralysis of the hind quarters. After two hours the heart could not be felt beating, but catchy respirations continued for another hour.

Postmortem. There was clotting in the superficial vessels, and general venous engorgement.

INTRAVENOUS INJECTIONS.

The results of experiments as illustrated by simultaneous tracings of carotid blood pressure and respiratory movements do not altogether agree with Briot's statement that death, in the case of intravenous injections, is due to respiratory failure. The action appears to follow the course of that which occurs with most Snake venoms, *i.e.*, a slightly preliminary rise, followed by a very rapid and deep fall in blood pressure.

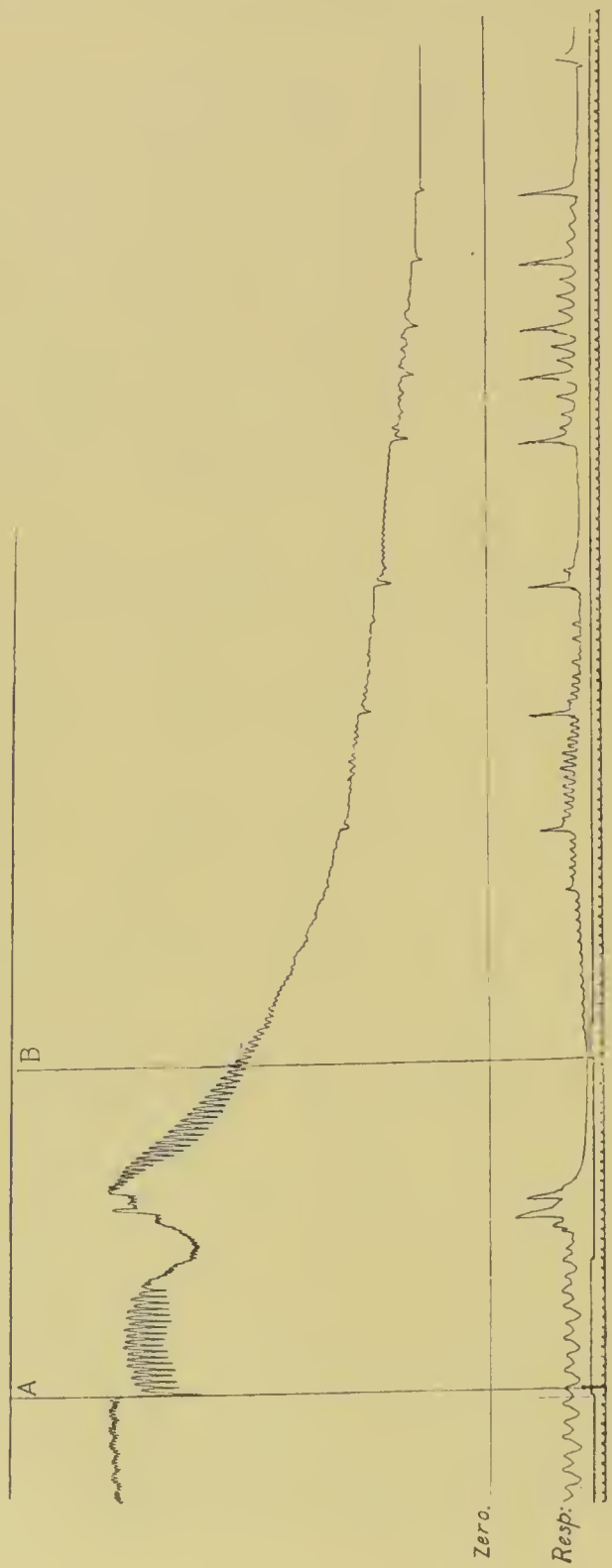
Experiment 1. Rabbit, weight 1,900 grms., anæsthetic ether. After an injection of .05 grm. dried poison, there was a fall in blood pressure lasting forty-five seconds. Then, after twenty seconds of irregular low pressure, the pressure gradually rose. After an interval of seven minutes, during which the cardiac pulsations had steadied down to a normal rate, a further .05 grm. of dried venom was injected into the femoral vein. Immediately the blood pressure fell rapidly for twenty seconds with almost imperceptible cardiac pulsations, and in

two and a half minutes a further fall took place immediately preceding complete cardiac failure and death.

Experiment 2. Cat, ·1 grm. dried venom, weight 3.400 grm. Ether. Immediately after injection marked fall of blood pressure and eighteen slow powerful beats in ten seconds, *i.e.*, 104 per minute (normal—192 per minute). This was followed by a rise of blood pressure in ten seconds to normal, and then another gradual fall with marked slowing of the beats. Thirty-three seconds from first injection the cannula was washed out with .86 % sodium chloride solution, and the cardiac contractions became gradually small and the pressure continuously fell so that two minutes from the commencement of experiment the heart had ceased to beat. During this time the respiration although affected so as to become at first shallow and then every fifteenth breath a deep inspiration continued, and there were nine deep inspirations during the period of nearly two minutes which elapsed between the last cardiac beat and the last respiration. This tracing shows in a very convincing way the typical fall of blood pressure, the result of an intravenous injection of a venom and controverts the theory the cause of death is in the case of Weever poison always due to respiratory failure.

Experiment 3. Cat, weight 3.300 grms. Ether. Injected with ·1 grm. dried venom dissolved in 5 C.C. of an 86 % sodium chloride solution, the resulting solution was then centrifugalised and the clear fluid injected into the femoral vein.

For twenty seconds from the commencement of the injection there was a slight fall in blood pressure followed during the next fifteen seconds by a slight rise. Then forty seconds from the commencement of experiment there was a gradual and deep fall of pressure, reaching its lowest point two minutes from the commencement. During this fall the cardiac pulsations became less strong, the rate being 150 per minute as against a normal of 168 per minute. During the first thirty seconds the respirations were eight per minute as against a normal of nine per minute; they gradually quickened until at the end of the second minute they amounted to from fourteen to twelve per minute. Four minutes from the



Experiment 2. Cat under Ether. Upper line shows cardiac pulsations and pressure in carotid artery.
A. Injection ·1 grm. dried venom. B. Cannula washed out with Salt solution.
Resp. = Respiratory movements. The lowest line = seconds.

commencement the respirations had slowed down to six per minute, with cardiac pulsations stronger, ninety-six per minute. At the eighth minute the respiration became very slow, while during the ninth minute respirations were very irregular, four per minute with clonic twitching of abdominal and leg muscles. During tenth and eleventh minute there were only two respirations per minute with clonic twitchings. in fact, death almost resulted from respiratory failure. During fifteenth minute the animal began to recover six respirations per minute and heart 126. The experiment was then completed.

In this case death did not result from the immediate action on the cardiac system, but the later effects on the respiration nearly ended in death.

It would no doubt have been interesting from a scientific standpoint to have gone further and repeated these experiments after division of the nerves, but inasmuch as the poison is not in practice ever injected in sufficient quantity to cause death either by heart failure or respiratory failure, it seemed more important to study the local effects and the blood changes, which not infrequently result in man in phlegmonous inflammation and septicaemic conditions.

HÆMOLYTIC ACTION OF WEEVER POISON.

This has been studied up to a certain point by M. Briot. It has been established that Snake venom only produces hæmolysis in certain animals unless there is also present certain components of serum. If red corpuscles are washed in normal saline and venom is added no solution occurs. But if normal serum heated to 62° C. is added hæmolysis occurs. It is necessary to heat the serum to prevent an antihæmolysin present at low temperatures from protecting the erythrocytes against the solvent action of the venom.

Briot has repeated these experiments of Calmette on Snake venom with Weever poison. In a series of test tubes he put a drop of washed corpuscles in suspension in 2 C.C. of normal saline; he then added normal serum heated to 60° C. for

one hour and variable doses of his solution of Weever venom. Complete hæmolysis took place in one and a half hours. Two controls were observed, one without the venom and one without the heated normal serum ; in neither tube did solution take place, neither did it take place when unheated serum was added. Briot also observed that the hæmolytic effect of the venom remained intact after heating for an hour at 75° C., and that even after heating for twenty minutes at 100° C., dissolution took place, though slowly.

A most important contribution to the study of venoms was published by Flexner and Noguchi on hæmolysis by Snake venom in 1902. These authors found that although red corpuscles whose serum has been removed by washing are agglutinated by Snake venom, they are not dissolved. If, however, serum is added hæmolysis occurs. The conclusion is thus reached that Snake venom is made up of substances acting after the manner of amboceptors which are activated by certain complements of the serum. In fact, Snake venom does not act as a simple poison after the manner of toxins but in a complex manner, being identical in action with the hæmolysins of blood serum, as this has been conceived by Ehrlich and Morgenroth.

Kyes proceeded to experiment with Cobra venom on the blood of different animals and found that there were two groups of blood cells. 1. Those that are in themselves dissolved by Cobra venom. 2. Those that are only affected by venom after the addition of other substances, complements, etc. He then proceeded to show that the red corpuscles that were in the first group were only acted upon by the venom because they themselves contained endocomplements which allowed the amboceptor of the venom to act on the cell.

It is not for me to discuss the experiments which proved this point, but they are very convincing, and there seems no doubt that certain blood cells themselves contain complement-like substances or endocomplements, and later research has shown this complement-like substance to be due to the lecithin in the stromata.

The following experiments I carried out with venom extracted from recently caught fish. Hæmolysis took place without the addition of sera with the blood corpuscles of Roach and Perch when one drop of venom was added to a suspension of their blood corpuscles made according to Briot's technique.

It seemed important, having made these preliminary investigations with the blood of fish, to carry them further into the realm of warm-blooded animals, and for this purpose I provided myself with an excellent centrifuge worked by water power made by Baird and Tatlock. The blood of the following was used :—Pigeon, Guinea-pig, Sheep, Dog, Ox, Horse and Man. The more exact methods of hæmolytic experiments as employed by Ehrlich's School and fully described in an article by Morgenroth in Ehrlich's collected studies on immunity, were used in these investigations.

The blood having been defibrinated, was centrifuged to remove the serum, which was carefully pipetted off. 10 C. C. of normal saline was added to .5 C. C. of corpuscles and well mixed, centrifuged and the clear solution pipetted off. This was repeated three times and finally a 5 % emulsion of red corpuscles was made in .85 salt solution. either 2 C. C. or 1 C. C. of this solution was put in a series of tubes, the poison added in varying doses and the mixtures put into the incubator for two or more hours. They were then allowed to settle in a cool place for several hours.

With Pigeon's blood one drop of a 50 % solution of fresh Weever poison was sufficient in two hours to produce marked hæmolysis.

The poison solution used was obtained by extracting the venom with a needle and syringe previously sterilised : in order to get all the milky fluid from the syringe, an equal quantity of salt solution was added to wash it out, so that one obtained a 50 % solution of fresh poison. This was kept in a cellar on a block of ice in the dark and in this way its virulence remained intact. From a great number of experiments I found that uniform results were obtained if the poison was removed from freshly caught fish, and extracted

at once. It appears, as the fishermen state, that the poison loses its effect soon after death. With one specimen of venom I got most contradictory results which were due to my using a batch of 100 fish which were not quite fresh although they had been kept on ice.

The effect on birds is interesting, in as much as a smacksman has related to me how he has seen Gulls fall into the sea as if struck dead when he has thrown live Weevers overboard to them. With Guinea-pig corpuscles two drops of 50 % Weever poison were added to one tube containing 2 C. C. emulsion, and to two other tubes the same quantity of Weever poison + in one tube some normal serum and in another serum heated for an hour at 62 C. In all three tubes marked hæmolysis took place ; in the controls none.

We see here again the presence of endocomplements in the Guinea-pig corpuscles, and we had a slightly greater action with the presence of heated serum than with unheated serum.

A similar experiment was made with Sheep's blood. In this case with 5 % emulsion and two drops 50 % Weever poison, there was advanced hæmolysis, and with the same quantity of poison with both normal serum and serum heated for an hour at 62° C. there was complete hæmolysis after two hours in the incubator at 37° C. We have here a very marked example of the amboceptor of Weever poison combining with the endocomplement of the Sheep corpuscles resulting in rapid hæmolysis. The increased hæmolysis with the added serum was not affected by heating to 62° C. A similar experiment with two minims of Weever poison gave the following results, *a*. with blood corpuscles only, hæmolysis in one hour ; *b*. with heated and, *c*. unheated serum, complete hæmolysis in half an hour.

With human blood we find that there is hæmolysis of the washed corpuscles without the addition of serum. But unless the venom is quite fresh one drop of the 50 % solution is not sufficient to produce hæmolysis, although two drops suffice. It seemed important in the light of Briot's investigations previously referred to to be quite sure of this. The following experiment was very conclusive. Six tubes, each

containing 1 C. C. of 5 % washed human corpuscles, were numbered 0, 1, 2, 3, 4 and 5. 0 was the control.

1. contained 1 drop 50 % Weever poison.
2. ,, 2 ,, ,, ,, ,,
3. ,, 3 ,, ,, ,, ,,
4. ,, 4 ,, ,, ,, ,,
5. ,, 2 drops + 1 C. C. normal serum.

0, underwent no change after two hours at 37° C.

1, showed medium hæmolysis with dark red sediment,

2, showed well marked hæmolysis with dark pink sediment.

3, ,, ,, ,, ,, ,, ,,

4, showed very marked hæmolysis, almost complete; sediment being merely faint pink.

5, showed complete hæmolysis.

There seems no doubt that trachinus venom can dissolve human corpuscles without serum, and that normal unheated serum does not delay but rather increases the solution. Experiments were made to endeavour to activate venom insufficient to dissolve the human corpuscles by means of Sheep serum and Ox serum. A venom of which one drop did not dissolve washed human corpuscles, was mixed with .3 C. C. sheep serum, and a control was made with sheep serum only. The result was that with one drop Weever poison + .3 C.C. sheep serum there was marked hæmolysis; the control showed agglutination but very faint hæmolysis.

A similar experiment was made with ox serum .1 C. C. of which was used for activation. There was complete hæmolysis with Ox serum + one drop Weever poison, and slight hæmolysis in ox serum and blood alone. In both the above experiments there were two other controls, with the corpuscles and Weever poison and no hæmolysis occurred.

I have made experiments with the idea of activating the venom towards human blood by means of lecithin, and have succeeded on two occasions: but as other experiments have not given uniform results, I am continuing this investigation with lecithin recommended by Preston Kyes.

Horses' blood gives the hæmolytic reaction with washed corpuscles alone.

Seven tubes were filled with 1 C. C. of 5 % emulsion.

With 1 drop Weever poison slight hæmolysis.

With 2 ,, ,, ,, well marked,

With 2 ,, ,, ,, + .05 C. C. normal serum, strong hæmolysis.

With 2 ,, ,, ,, + serum heated for half an hour at 62° C. slight.

The controls were all negative.

Ox blood gave similar results.

With 2 drops Weever poison well marked hæmolysis.

With 2 ,, ,, ,, + .5 C. C. 1-10 normal serum, well marked.

With 2 ,, ,, ,, — .5 C. C. 1-10 heated serum, strong hæmolysis.

The results of these experiments amount to the establishment of the existence of a hæmolytic property in Weever venom capable of dissolving washed corpuscles of all bloods so far experimented on without the addition of sera. That the addition of the serum of the same animal does not inhibit but rather increases the activity of the venom. That in most cases heating the serum for an hour to 62° C. diminishes its activating power. That minimal doses of the venom can be activated by the sera of other animals in the case of man, or the corpuscles are rendered more susceptible to the poison. That probably the poison is an amboceptor, which unites with the endocomplements of the blood cells.

The neurotoxic effects of the poison have not been fully worked out at present, as I have been unable to spare the time away from practice, but I am continuing my investigations in this direction and also studying the effect of the venom on bacteriolysis.

Treatment. Recent cases have been treated successfully by the following method. The part pricked should be separated from the general circulation by a ligature, and if the lips are not sore the wound should be sucked. The wound should then be freely incised and a fresh solution of permanganate of potash, or hypochlorite of lime, or chloride of gold 1 % rubbed into the part.

VII.

THE POISON APPARATUS OF THE WEEVER.

By J. O. Borley, M.A.

Read 27th November, 1906.

The Weever is at certain seasons of the year such a common fish on our Eastern Coasts, and the effects following a sting are so marked and painful, that it is a matter of some surprise that the fish, and especially its poisonous properties, have not been the subject of more continued and detailed study than has been the case. Probably the circumstance is one more instance of the isolation of the seafaring sections of the community from their land-dwelling countrymen: an isolation preserved by difference of interests, of ways of life and even of language. Be this how it may, the fishermen themselves seem to have invented the only attempts at cures for the sting of the Weever which can be said to be generally known or used among them; and of these cures not one of the least interesting features is that they generally include the burning of the body of the Weever, and sometimes the application of its ashes to the wound—a curious little remnant of sympathetic magic.

It is the purpose of the present short paper briefly to describe the anatomy of the poison apparatus of the Weever, in order to familiarise those not acquainted with the fish with the main features of the organs in which the poisons shown by Dr. Evans to possess such powerful and interesting effects originate.

There are two British species of Weever, *Trachinus draco* and *T. vipera*. The poison apparatus is practically identical in structure in these two species, but in the latter, which is

distinguished as the Lesser Weever, they are larger in proportion to the size of the fish. The poison glands are lodged in α 5 or 6 rays of the dorsal fin, and β a spinous outgrowth of the opercular bone.

Fig. 1. Opercular bone of *T. draco*, showing spine and (shaded part) groove for poison gland.

Of these two organs the former is by far the more conspicuous and the less powerful. Very probably the black pigmented membrane between the dorsal spines has the effect of warning other fish of the wisdom of avoiding the Weever ; its flesh is very good to eat, and were the fish unprotected it would probably be preyed upon by other fishes to a considerable

extent. The far more deadly opercular spine is hidden when the fish lies in its characteristic attitude, half buried in the sand with its dorsal fin erect and protruding. This probably explains the absence of any conspicuous pigment in the region of the operculum.

The opercular spine is a process of the opercular bone (see Fig. 1). It is singularly like a flat dagger in shape, except that the guard and the handle fuse, and so do not make a cross. The edges of the dagger are grooved from tip to hilt, the grooves being quite distinct; and where the blade joins the hilt the grooves continue as small pockets hollowed out of the opercular bone.

The poison glands are pear-shaped masses of creamy white material of exceedingly lax and loose texture, whose broad ends are included in the pockets, whose side lies in the groove, and whose tip reaches nearly the end of the spine. They do not lie free in a cavity, but are surrounded and held in place by a network of connective tissue attached to the opercular bone, the opercular membrane and the spine. Their tips, however, lying in the grooves near the tip of the spine, have only a temporary covering, the groove being here roofed in by a loose sheath formed by the inturning of the surface layers of the skin. The disposition of this sheath cannot be understood without some little attention. It is perhaps best expressed by saying that where the spine issues from the substance of the operculum it is still at the bottom of a tube sunk in the operculum, this tube being the sheath. This tube wrinkles down about the spine as the latter enters a victim until about one-third of the spine is uncovered.

The anatomy of the gland is known to us mainly by the work of Gressen in France, Newton Parker in England and Bottard in France. Our knowledge, especially of the histology, is, however, far from complete. I had hoped to exhibit sections of the gland at various levels and especially through the groove, where it is stated there is no true duct. Unfortunately the length of time taken in decalcifying my specimens has prevented this, and I am indebted to Dr. Evans for kindly furnishing me with slides of his own

(mostly from that part of it within and near the pockets) for the opportunity of making out the following particulars.

The gland consists of—

(α) A capsule of connective tissue, mainly of ordinary fibres, but some elastic.

(β) An exceedingly rich network of capillary blood vessels in this capsule. These seem entirely confined to α in the wide pear shaped end of the gland, but nearer the tip pass among the secreting cells.

(γ) Extremely large secreting cells elongated in shape and arranged in radiating columns. These completely fill the gland except for narrow spaces in the centre occupied by the secreted substance.

The secretion product appears to be in two states. There are, first, masses of finely granular material, readily staining red with carmine, and secondly, highly refringent masses of colloidal appearance, staining yellow with picric acid and very little if at all with carmine. In sections both are found, but only one, the colloidal, within the cells. It is found in the terminal cells of the columns referred to as radiating inward, and therefore near the central masses of secretion.

In some cases a whole column of cells will be replaced by a granular mass which reaches from centre to capsule. Whether, therefore, the colloidal substance breaks down into the granular mass, or whether the whole cells break down as their arrangement in columns might suggest, is not clear. On one occasion I saw some fresh cells burst, emitting a fluid; but what appearance this fluid would have borne in a fixed section one cannot say. In any case, however, there are present, plainly, either two secretions or two stages of one secretion: and it is possible therefore that the various physiological effects of the poison may be due to different substances. At all events we are not surprised to find these effects other than simple. The very ample blood supply of the gland is worthy of note. It is highly probable that there is a perpetual waste of secretion into the sea, though this is minimised by the closeness with which the sheath fits the spine; and secretion would, if this be so, need to be rapid in order to keep up

a good supply of venom. This may be the reason for the well developed system of capillaries.

The cells in the portion of the gland nearer its apex are different in both form and arrangement. They are roughly spherical, arranged in spindle-shaped masses, and the capillary blood vessels penetrate between them instead of being, as in the basal part of the gland, confined to the capsule or bed of the secreting cells.

The dorsal glands are in the Weever unimportant. They are said to be similar in structure to the opercular and are situated in pairs, one on each side of a keel which projects back from the spines.

The poison glands of the Weever are generally considered to be modifications of glands of the skin. They much resemble sebaceous glands, and glands have been found in the head of the Perch which would well represent an intermediate stage between the two types of sebaceous gland and venom gland. Although poison glands of very similar type have arisen in practically all groups of fishes, the group *Jugales*, to which the Weever belongs, are especially rich in poisonous fishes, and all the species belonging to the genus *Trachinus* namely *T. draco*, *vipera*, *araneus*, and *radiatus* are armed with poison apparatus of the type considered in this note.

VIII.

SOME OLD-TIME NORFOLK BOTANISTS.

By Thos. Southwell, V.-P.

Read 28th January, 1907.

The County and City of which we are proud to claim membership have always been noted as the home of a succession of men who excelled beyond the common in all branches of science and art; but more especially was this the case in the second half of the 18th and early years of the 19th century; at that time there existed here quite a little colony of such men forming a society of their own irrespective of rank or social position. From the Bishop's palace to the weaver's cottage were to be found those whose chief happiness during their leisure hours was the study of Natural Science, Literature or Art. This displayed itself in 1784 in the establishment of our excellent Public Library, followed in 1822 by a Literary Institution for the supply of more exclusively scientific works than are usual in a Library of mixed literature, and from this Institution in 1824 originated the fine Museum so well displayed in the ancient Castle of Norwich.

Our County has given two presidents to the Royal Society, Dr. Wm. Hyde Wollaston in 1820, and Sir J. D. Hooker in 1873, and it is an interesting fact that in the former year the presidents of three distinguished Societies, and two of the principal officers of two others were natives of this County,* viz., Dr. Wollaston, president of the Roy. Soc.; Sir James E. Smith, of the Linnean Society, and Dr. Astley Cooper, of the Chirurgical and Medical Society. Mr. Richard Taylor was Secretary of the Linnean Society, and Mr. John Taylor, Treasurer of the Geological Society.

* Norf. Chron., 8th July, 1820.

But it is to the Botanists which Norfolk has produced that I wish to call your attention, more especially to those who flourished in the period I have just mentioned; and it has occurred to me that it might be of interest to bring together the scattered records of these pioneers of botanical science, so far as they are connected with our own County of Norfolk; this I have endeavoured to do in the following notes, the only merit, if any, of which is that they are presented in a connected form. I think we may assume that botany of a kind flourished here at a much earlier period than that named, for where there was held a Florists' Feast it is fair to suppose there were Florists to organise the feast, and a printed edition of a play called "Rhodon and Iris,"* dated 1637, is in existence which was produced at the "Florists' Feast" in the City of Norwich 270 years ago. Sir Thomas Browne who died in 1682, is also said by Ray to have been the first to record the discovery of *Salsola fruticosa*, now a very abundant plant, on the Norfolk coast. It is much to be regretted that the learned Doctor did not do for the Botany of Norfolk what he did for the Birds and Fishes, thereby enabling us to appreciate the changes which have taken place since his time, for it is evident from the writings which he has left, particularly in the disquisitions to be found in chapters iii and iv of the 'Garden of Cyrus,' that he was quite well informed in the botanical literature of his day, and doubtless also equally well acquainted with the floral productions of his adopted County, in fact nothing came amiss to his immense store of erudition, and as Le Strange remarks in his critique on the *Pseudodoxia epidemica*, "I cannot but predicate the vast expanse of the Drs.' learning, reading, and knowledge, from the Cedar to the Hyssope."

* 'Rhodon and Iris,' a Pastorale as it was presented at the Florists' Feast in Norwich, May 3rd, 1637. London, &c., 1637. The author of 'Rhodon and Iris' one Ralph Knevet (1600–1671), was connected in some way with the Paston family, probably as Chaplain or Tutor, and is believed to be identical with a Rector of Ling of that name, who held the Living from 1652–71, and according to Blomfield (vol. viii. p. 251) lies buried in the Chancel of that Church.

Robert Marsham, F.R.S., who was born in 1708 at Stratton Strawless, where, with the exception of the foreign travel which at that time formed part of the education of an English gentleman, he constantly resided, could not be styled a systematic botanist, in fact, at that time system in Natural Science was practically unknown; but he was an ardent lover of nature and a most devoted and skilful arboriculturalist, he delighted in planting and experimenting on the treatment and growth of trees, some of which are still to be seen at Stratton Strawless. His Calendar of the "Indications of Spring," commenced in the year 1736 and continued to the present day by his successors, is the most remarkable continuous register of natural phenomena in existence; but although he lost no opportunity of adding to his knowledge of arboriculture both at home and abroad, he did not neglect other branches of Natural History, and we are indebted to him for the first detection of a beautiful Continental bird, the Wall Creeper, in Britain. How lovingly he followed his favourite pursuit may be judged by his remark when writing directions for the pruning of trees. "I love them as my children," he writes, "and cannot act with my own judgment"; it is said that no gardener should thin out his own grapes, and Marsham's tenderness for his trees rendered to him their effectual pruning a painful operation. How greatly he was esteemed by his correspondent, Gilbert White of Selbourne, may be judged by the latter's pathetic exclamation in one of his letters, "O, that I had known you forty years ago!" He died at Stratton in 1797.

Contemporaneous with Marsham and six years his senior, born at Wood Norton in 1702, was Benjamin Stillingfleet, the close friend and frequent visitor to the former; never in affluent circumstances, Gray says that on his removal to London, he lived in a garret that he might support some near relations, but being always employed he was always cheerful and happy. His voluminous writings extended from polities to the 'Power of Harmony,' which latter, the latest of his works, Dr. Burney characterised as a "Masterly performance"; but it is his botanical works which concern us. When

he resided at Foxley he experimented on the agricultural value of various species of Grasses and the trivial names which he adopted for them in his published 'Observations' are said to be still in use. While staying with Marsham at Stratton in 1755, he wrote his celebrated 'Calendar of Flora,' not published till 1761, and in 1759 issued from his pen the 'Miscellaneous Tracts, relating to Natural History and Gardening,' translated from Linnæus with notes by himself; this passed through three editions, the preface of which has been styled "the first fundamental treatise on the principles of Linnæus published in England, so that the issue of this work may be considered as the era of the establishment of Linnæan Botany in England." It seems curious that a man of science like Stillingfleet should have given rise to a term which has become stereotyped in the English language as the equivalent of a learned lady, to wit, "Blue Stocking," yet so it is. Stillingfleet formed one of a number of individuals who used to meet at the house of Mrs. Elizabeth Montagu "for rational conversation without cards," a quite original departure in those days, and the fact of Stillingfleet's appearing at these meetings in unconventional blue worsted stockings led to this little coterie being so styled. Dr. Samuel Johnson applied to Mrs. Montagu the term "Queen of the Blues," and this led to the subsequent somewhat opprobrious use of the appellation, "Blue Stocking," to ladies who ventured to be more intelligent than was common. Stillingfleet died in 1771.

At the beginning of the 19th century and perhaps long before, floriculture had been very popular among the weavers in Norwich, but there were others, mostly in humble circumstances, who amused themselves in "herborising" in the country, referring their discoveries to the names and descriptions of old English authors particularly Gerard and Parkinson, and sometimes perhaps to Ray. Sir J. E. Smith speaks of these people being very numerous at that time and sometimes very successful, he attributes their love of floriculture to their Dutch origin: but it must not be imagined that these men were all mere dilettanti, many of them were very successful

in their finds ; Sir J. E. Smith mentions several such and of one he writes, in a letter printed in the Linnean Trans. in 1793 (vol. ii. p. 315), "to do justice to unostentatious ingenuity," that Joseph Fox, a journeyman weaver of Norwich, was the first to raise a Lycopodium from spores. "He showed me in the year 1779, young plants [of *Lycopodium selago*] raised from seed in his own garden. This humble observer," he adds, "whose name has not yet appeared in any book, is the original discoverer of many rare plants in the County of Norfolk, and it is with pleasure I commemorate his former assistance to myself." We who are aware of the marvellous phenomena which attend the development of a Cryptogam from its spore can well imagine the wonder and delight with which this all but unknown weaver must have watched the, to that time, unknown process. We can hardly conceive in the present day the hardships these men endured : it is stated that in the year 1801 there were in Norfolk 12,000 looms for the manufacture of shawls, crapes, bombazines and camlets, employing in the aggregate 72,000 workmen who were paid, some of the best weavers 14s. to a guinea a week, weavers in general not more than 6s.,* and it may be imagined, wheat being 146s., 168s. and 180s. per quarter in the first three months respectively of that year,† the hardships these poor men must have endured whilst it is also said that at the same time the annual export value of Norwich manufactures was £1,200,000—but this is a digression. For some reason—possibly owing to the grinding poverty these men endured and the gradual cessation of hand-loom weaving in Norfolk—we hear very little of these amateur botanists after the period to which I am now referring; but some of them long survived as "herbalists," or medical botanists, students of Gerard and the early writers—one such I was acquainted with not long ago who was a curious mixture of intelligence and mysticism.

We have now reached a period when a definite system of classification gradually came into use and botanists were no longer simple collectors.

* Fenland 'Notes and Queries,' vol. vi. p. 376.

† 'Norfolk Remembrancer,' 1801.

In 1735 appeared the first edition of the *Systema Naturæ* of Linnæus, which, however imperfect we may regard it at the present time, was an immense improvement on the state of chaos which had previously prevailed, whilst the bi-nominal* method of nomenclature introduced in his *Species Plantarum* in 1753 speedily led to the abandonment of the clumsy descriptive terminology at that time in use. Our great countryman, Ray, had, to a large extent, prepared us for this change and had indeed foreshadowed in his *Methodus Plantarum* the natural system now in vogue, to be referred to later on, and I have already mentioned the part which Stillingfleet took in popularizing the great Swedish Naturalist's works amongst British Botanists, but perhaps the most strenuous supporter of the Linnean system in this Country was our own citizen Sir James E. Smith, whose history is so well known that a very brief notice here will be sufficient.

Smith was born at Norwich on 2nd December, 1759. He studied medicine in Edinburgh, and subsequently in London, under John Hunter, and took the M.D. degree at Leyden in 1786. The medical profession, however, seems to have possessed very little attraction for him and the purchase of Linnæus's Library and Collections in the year 1784, although it did not deter him from proceeding to his degree, was the means of diverting his whole energies to botanical pursuits, and medicine took a subordinate place in his very active life. Smith founded the Linnean Society in 1788, and was its first president. In 1814 he was knighted by George IV., and died in Surrey Street, Norwich, 17th March, 1828, leaving a widow who survived him till 1877, dying at Lowestoft at the age of 104 years. Of the many works which issued from

* Caspar Bauhin in his '*Pinax Theatri Botanici*' issued in 1023 (a work I have not seen) largely uses a bi-nominal terminology, but Mr. B. B. Woodward informs me that this was only done for the sake of brevity in lettering his illustrations, and not with a view to its introduction as a system. The Rules adopted by the International Botanical Congress at Vienna (1905) accept the earliest specific name of a plant, no matter under what genus it was first described, and the names of plants date from the First Edition of Linnæus's *Species plantarum* (1753).

his pen the best known are the 'English Botany,' 1790-1814 and the 'English Flora,' 1824-1828.

It is needless to say that Sir J. E. Smith numbered amongst his friends and correspondents all the botanists of note, both at home and abroad, amongst whom were DAWSON TURNER, F.R.S., of Yarmouth (1775-1857), and LILLY WIGG (1749-1828) of the same town. The former was a man of many parts, Scholar, Antiquary, and Botanist; his chief botanical work was a monograph of the British Fuci (1808-1819), in which he was ably assisted by Lilly Wigg, he was also joint author of the 'Botanists' Guide through England and Wales' (1805), in the Norfolk section of which Wigg also helped.

LILLY WIGG was a man of humble origin, but much esteemed by his contemporary botanists, he made more than one addition to the British flowering plants, and many to the Marine Algæ, one of which *Naccaria Wigghii* was named after him. He and John Pitchford, to be mentioned presently, were elected in 1790 in the list of original Associates of the Linnean Society.

In his interesting communication to the Linnean Society on Several Norwich Botanists, in addition to the weaver, Joseph Fox, before referred to, Sir J. E. Smith mentions his indebtedness to a MR. WILSON, a tailor, part of whose herbarium, formed about the years 1738 and 1740, and scientifically named, had fallen into his hands. CHRISTOPHER SMART, also a tailor, CHRISTOPHER NEWMAN, "a man in a more elevated station of life," and WILLIAM HUMFREY, were pupils of Wilson. To Humfrey Sir Edward refers as "an amiable and communicative man," to whom he had many obligations, he was the discoverer of *Lycoperdon phalloides*. "The short and simple annals," continues Sir James, "of these humble and disinterested admirers of Nature may seem, perhaps, scarcely worthy the attention of the learned and accomplished naturalists, but those who have the best claim to such a denomination will feel most interest in the success of their fellow labourers, how far so ever below their own."

JOHN PITCHFORD was a Surgeon who settled in Norwich in 1769, and of whom, on his death in 1803, Sir J. E. Smith

contributed an obituary notice to the Linnean Society, of which the deceased was a member. Pitchford's chief work was the study of the *Carices* and *Menthæ*, sufficiently difficult orders, and Sir James remarks that he was "the last of a school of botanists in this town among whom the writings and merits of Linnæus were perhaps more early, or at least more philosophically studied and appreciated, than in any part of Britain."

Another and more distinguished contemporary Norfolk botanist mentioned by Sir J. E. Smith was JAMES CROWE, a Surgeon of Lakenham, who died in 1807. In an appreciative memoir Sir James states that to his constant attachment and friendship he was indebted for much of the choicest social happiness he enjoyed in his residence in Norwich, adding that "to the more difficult parts of British botany he had given peculiar attention, especially to the Mosses and Fungi, but above all to the Willows, a tribe of plants, which . . . before his time had been almost entirely unknown to botanists, so confused were their ideas concerning them."*

But, above all, Smith expresses his admiration for and indebtedness to another supporter of the Linnean system Mr. HUGH ROSE, the author of the 'Elements of Botany' (1775). "I can never forget," writes Sir James, "the kind assistance I received from this worthy man, when, having always had a passion for plants, I became desirous, at the age of 18, of studying botany as a science." The Rev. HENRY BRYANT, who enjoyed various Norfolk benefices (1721-1799), author of 'A particular enquiry into the Cause of that disease in Wheat commonly called Brand.' (8vo. 1784) is spoken of as a man skilled in mathematics and natural science, also his brother CHARLES BRYANT, the author of the *Flora diætetica*; both died in the year 1799. Another student of Cryptogamic botany was THOMAS JENKINSON WOODWARD of Bungay, his chief studies were Fungi and Fuci.

* *Salix crowcana* is named after him, and he had a *Salicetum* or experimental garden for Willows at Lakenham, but I know not whereabouts it was situated.

The Rev. CHARLES SUTTON, D.D. (1756-1846), for many years perpetual Curate of St. George, Tombland, and Vicar of Thornham and Holme, was an ardent botanist, and an Associate of the Linnean Society to whose Transactions he contributed a monograph of the genus Orobanche, establishing a new species, *O. elatior;* he contributed a number of the drawings to Sowerby's English Botany, and A. Richard established the genus Suttonia in his honour. An obituary notice of Dr. Sutton will be found in vol. i. of the Linnean Soc. Trans., p. 341.

But we have now arrived at a period when the system propounded by Linnæus and founded on the sexual organs of plants, which although highly artificial had been greatly superior to anything which preceded it, and which we have seen was so ably promulgated in this country by Stillingfleet and Sir J. E. Smith, gradually gave way to a more natural system based on a closer study of vegetable physiology, and a form of arrangement adopted by John Ray, the Essex Naturalist (1627-1705), in his *Methodus plantarum*, which appeared in 1682, may be considered as the dawn of modern botanical science. Jussieu (1748-1836) followed Ray to a certain extent in his *Genera plantarum* (1778-1789), which indicated an important advance in the principles of classification; one of his earliest supporters in France being A. P. De Candolle (1778-1841), who improved upon the work of Jussieu, and his system, with some modifications, is generally adopted in the present day. In this country we owe, in a great measure, the introduction of the "Natural System" to Robert Browne; born at Montrose in 1773; after various experiences at home and abroad he settled in London and became Librarian to the Linnean Society, also to Sir Joseph Banks. To his important contributions to botanical science is mainly due the universal adoption in this country of the system which now prevails.

One of the earliest supporters of the new system was SIR WILLIAM JACKSON HOOKER, who was born in Norwich on 6th July, 1785, and owed his devotion to British botany largely to the influence of Sir J. E. Smith, and to his father-

in-law, Dawson Turner. In early life he applied himself to Entomology and Ornithology, but later on botanical studies claimed his entire energies. His published contributions to botanical science are too well known and too numerous to mention here; he died in 1865, leaving an equally distinguished son, the present Sir J. D. Hooker.

Another celebrity whom we are proud to claim as our countryman was JOHN LINDLEY, who was born at Catton, near Norwich, on 5th February, 1799.

Lindley's early career was a somewhat chequered one: the son of a nurseryman at Catton by no means in affluent circumstances although of good family, he was educated at the Norwich Grammar School under Valpy; at 16 years of age he was sent to Belgium as agent for a London Seed-merchant, but on his return to England he devoted himself to the study of botany, having the advantage of the friendship of W. J. Hooker who introduced him to Sir Joseph Banks, in whose Library he found occupation—from that time his success as a botanist was secured, and critical works on the science flowed rapidly from his pen. Like Hooker he was a staunch advocate of the Natural as opposed to the Linnæan system of classification as evinced by his 'Introduction to the Natural System of Botany,' published in 1830. In 1829 Lindley was chosen the first Professor of Botany in the London University, having been elected a Fellow of the Royal Society in 1828. His writings on botanical subjects were many and various and he was greatly esteemed both in this country and abroad. Lindley died of apoplexy on 1st November, 1865.

Although his reputation rests on his distinguished services to the medical profession rather than as a naturalist, SIR JAMES PAGET was no mean botanist. He was born at Great Yarmouth in January, 1814, where he commenced his medical studies, proceeding to St. Bartholomew's Hospital, and passed the College of Surgeons in 1836: he soon obtained great distinction in his adopted profession, was created a Baronet in 1871, President of the College of Surgeons in

1875, and in 1884 was made Vice-Chancellor of the University of London. In early life, Paget was associated with a remarkable group of Naturalists at Yarmouth, of whom it is only necessary to mention Dawson Turner, Lilly Wigg, the Revs. C. S. Girdlestone and Richard Lubbock, as well as his brother Charles John Paget, who died in the year 1844 at the age of 32. Together the brothers Paget produced an admirable 'Sketch of the Natural History of Yarmouth,' published in 1834, containing a comprehensive list of plants found in that neighbourhood. The Herbarium which he formed at that time and which he used in his teaching in London, he presented in 1885 to the Norwich Castle Museum where it is carefully preserved. Sir James Paget died in London on 30th December, 1899, full of years and honours.

I have already mentioned the Rev. Dr. Sutton who held the perpetual Curacy of St. George, Tombland, which living he resigned in the year 1842, and it is not a little singular that his successor, the Rev. KIRBY TRIMMER, who had been his Curate since 1840, was also devoted to the study of Norfolk botany. Although not born a Norfolk man, Trimmer spent all his active life in this County, his first Curacy being at Burnham Overy in 1829, thence he removed to Great Bircham in 1833, and Norwich in 1840. His experiences in various parts of the County and the many friendships thus formed with kindred spirits rendered him peculiarly fit for the task which he undertook of producing a 'Flora of Norfolk,' which appeared in 1866, and an undated Supplement in 1884 (not 1885 as stated in the *Journal of Botany* Dec. 1887, vol. xxv. p. 383-4). Trimmer made a special study of the difficult family of the Mints, also of the Fungi and Lichens, and his work has formed the basis of the lists which have appeared more recently. Trimmer died on 9th October, 1887, having been incumbent of St. George, Tombland, for 45 years.

We are now approaching very near to our own times, but there is one more name, and that a very familiar one to us all, which I cannot omit from this record of Norfolk botanists. I refer to one who was one of the founders and three times

president of this Society—HERBERT DECIMUS GELDART. Mr. Geldart was born at Norwich in the year 1831, the son of one who took an honourable position in a literary circle which flourished in this County and City early in the 19th century, which reputation he amply sustained. There was scarcely a branch of Natural History, including microscopy, on which he was not singularly well informed, but his special subject was botany on which he contributed many papers to the Transactions of our Society, especially the lists of Flowering Plants and Ferns in the published Fauna and Flora of the County, and the admirable article on the same subject in the 'Victoria History of the Counties. Norfolk.' vol. i. But his contributions were not confined to local botany; in his Presidential Address to our Society in 1883, he expounded the theory of Symbiosis, or the physiological relationship of plants and animals, and in that of 1896, discoursed on the distribution of the Arctic Flora. In 1887 he described the plants collected by Capt. (Admiral) Markham in Hudson Bay, and in 1894, in conjunction with Col. Feilden, some valuable "Notes on a small collection of Spitzbergen Plants"; in 1896 "Contributions to the Flora of Russian Lapland," and "Contributions to the Flora of Kolguev," jointly with the same Arctic navigator. As to these valuable contributions to our knowledge of the Arctic Flora, Col. Feilden remarks in a letter to the Secretary of our Society—"his extraordinary general knowledge was combined with such accuracy and exactitude that I never found him tripping in the thousands of references that have passed between us. What I should feel inclined to dilate upon is the great knowledge, perseverance, and unflagging energy with which he worked out, in co-operation with me, the various collections that I brought back from time to time from the Arctic Regions." Mr. Geldart died on September 21st, 1902, to the universal regret of those to whom his great experience and ready help had so often been extended.

There are many other names I could mention, did space allow, of contributors to Norfolk botany who have passed

away, amongst them are the Revs. John Freeman of Ashwicken, William Blyth of Fincham, G. R. Leathes, R. Forby, H. Tilney, R. B. Francis and J. Alderson, Mr. Skrimshire, Mr. W. L. Notcutt of Fakenham, D. C. Burlingham and Dr. John Lowe of Lynn, Rev. George Munford, and others.

It is not my purpose to speak of the Norfolk botanists happily still living in our midst, but that the active prosecution of the study both of Phanerogamic and Cryptogamic plants is not neglected a reference to the valuable contributions to the Transactions of the Norfolk and Norwich Naturalists' Society will abundantly prove, and I trust that such may long continue to be the case.

IX.

NOTES ON THE NATURAL HISTORY OF THETFORD DISTRICT.

By W. G. Clarke.

Read 27th January, 1907.

The ten years which have elapsed since I communicated to the Society a "List of the Vertebrate Animals found in the spent away from the district, and my notes are consequently Neighbourhood of Thetford" (vol. vi. pp. 300-327) have been of such occurrences as have been communicated to me by friends, among whom I would particularly mention the Rev. R. B. Caton of Fakenham Magna, and Mr. F. Rix of Thetford, or observed by myself during occasional visits to the borough on the Little Ouse.

To the local names in my previous list may be added "Bog-mouse" for the Common Field Vole; "Guler" a

Brandon name for the Yellow Bunting; and "Swing-tree" for the Golden-crested Wren and Long-tailed Titmouse. The only recorded species on which doubt has been thrown are the Sand Lizard and Green Lizard, and for these there appears to be insufficient evidence. A query as to the nesting of the Short-eared Owl in the district may now be answered, for in the last week of May, 1898, an egg of this species was found on a heath at Barnham and identified by the Rev. R. B. Caton. It can also hardly be doubted from the evidence given hereafter, that the Hobby should be added to the 102 species of birds known to nest in the neighbourhood of Thetford.

Concerning the mammalia I have few noteworthy records. Cream-coloured Moles have been caught at Barnham and Kilverstone, and yellow specimens in a field near the river, opposite Burnt Hall, Fakenham. At the end of June or beginning of July, 1903, a dog Badger was caught in a rabbit trap on a heath at Elveden, and was so badly injured that it had to be killed. A few Otters have been killed each year on the Little Ouse or Thet. A dog Otter, 4 ft. 1 in. in length and weighing 25¼ lbs. was killed near the Nunnery, Thetford, on January 19th, 1900, and a female, 3 ft. 9 in. in length, on October 24th, 1903. One was shot at Santon Downham on November 15th, 1903, and two others at Shadwell on March 30th, 1904. Of the latter, one was 1 ft. 8 in. long, apparently about three or four months old, and the other was a female far advanced in pregnancy with milk oozing from its teats. Light-coloured Hares have been shot at various times, and on Bromehill, Weeting, a few years ago, there was a race of white Rabbits, and also a large number half white and half grey. On several of the large estates in the vicinity Rabbits have been practically exterminated, owing in one case to the possibility of race-horses being injured in their burrows, and in others to a belief that Rabbits and Game do not flourish in the same localities.

My list, previously published, of the species of birds observed within a six-mile radius of Thetford, numbered 183. The following additional species bring the total to 192—which

must, I think, be considered good for an inland district.* For a week in the early part of May, 1899, a Nutcracker (*Nucifraga caryocatactes*) was observed by Mr. T. Baring of Hockham, in a plantation of firs near Thetford, On September 9th, 1902, a Roller (*Coracias garrulus*) was seen at Rushford, and on October 29th, 1898, after severe gales, a young Gannet (*Sula bassana*) was shot between Barnham Common and London Road, Thetford. While shooting by the river Thet at Brettenham on August 12th, 1899, Mr. Fergusson secured a Little Bittern (*Ardetta minuta*). In the spring of 1903, two Ruddy Sheld-duck (*Tadoma casarca*) were seen several times on the river at Euston, and on April 13th, 1906, I saw two at Langmere by one of the round ponds south of the bluff. When they rose they came towards me uttering harsh cries, subsequently settling down by the long pool, where I watched them through field glasses for some time. On February 17th, 1906, a female in good plumage was shot near Thetford (probably at Wretham). There is a possibility, the Rev. R. B. Caton thinks, that these birds may have wandered from Elveden, where some are preserved. Red Grouse (*Lagopus scoticus*) were turned out at Elveden by Lord Iveagh about 1902, and as they have since bred with comparative success, are perhaps entitled to be added to our local list. Two Curlew-Sandpipers (*Tringa subarquata*) were shot at Thetford in the autumn of 1904 and preserved. In September, 1903, Mr. W. A. Dutt and I identified a Sooty Tern (*Sterna fuliginosa*) which was found lying dead on Santon Downham Heath at the end of March or beginning of April, 1900. This was a new species for Norfolk and Suffolk and the sixth English specimen recorded (*vide* vol. vii. p. 753). About February 12th, 1899, a Great Black-backed Gull (*Larus marinus*) was shot on Brandon Heath by Mr. F. W. Parrott.

In addition to species not previously recorded for the district, notes relating to birds in my previous list may perhaps be of some interest. Several variations in the plumage of common

* On February 10th, 1907, the Rev. R. B. Caton found a Little Owl (*Athene noctua*) hanging by a cord from an alder tree at Great Fakenham. This species has not previously been recorded for the district, and makes the total 193.—W.G.C.

species have been noted. In the last week of May, 1899, a nest of unfledged Blackbirds, consisting of four birds, was found at Barnham. One was of the normal colour, but the remainder were white. The finder endeavoured to rear them, but unsuccessfully, and they were preserved. In July, 1903, a pied Blackbird was shot at Coney Weston, and in July, 1904, a male Blackbird of a light chestnut colour with creamy-white quill feathers, was shot on Brandon Heath. On April 22nd, 1905, I saw a pied variety of the Wheatear, for such its flight unmistakably showed it to be, sitting on a fence by Peddar's Way, one mile north of Wretham. It was greyish-white with a band of black which came from the throat along the top of the wing and across the base of the tail. An almost pure black variety of the House Sparrow was trapped at Thetford on January 15th, 1899, and sent to me. A cream-coloured Starling was shot out of a big flock at Kilverstone the last week in July, 1904. A young Crossbill about a fortnight old was picked up near Thetford at the end of January, 1898, and a male Hoopoe in good plumage was shot at Brettenham on May 12th, 1900.

As is to be expected in such a strict game-preserving district several of the rarer Hawks have been shot, including a Marsh Harrier at Thetford on August 17th, 1905, a Montagu's Harrier at Santon in 1900, a Common Buzzard near Brandon early in January, 1901, an adult male Rough-legged Buzzard caught in a rabbit-trap at Thetford in 1899, and a Honey Buzzard near the same place in November, 1900. In the beginning of April, 1904, a female Peregrine Falcon was shot at Croxton: early in January, 1906, a male and female were killed near Thetford, the latter while chasing a Red-legged Partridge: and another was killed on January 16th. On September 6th, 1906, I watched for some time on Wretham Heath, the aerial evolutions of a pair which were screaming continuously. Adult male Hobbies were killed at Snarehill and Santon in 1902: on August 8th, 1903, a male and female and one nestling were shot at Rushford, and two other nestlings were seen. About the same time a young male was shot at Cranberry, Gt. Hockham. A hen bird was secured near

Thetford the last week in July, 1904, and a young bird on August 29th, 1905. There thus seems to be ample evidence of the breeding of this species in the district.

A young Bittern was killed by a warrener's dog at Shadwell in 1903, and early in January, 1906, a fine male was killed also by a dog, near the town of Thetford. For two years of the decade the heathland meres north of Thetford were quite dry, and only in the summer of 1904 and the spring of 1906 could they be fairly described as full. As a consequence the rare species of Wild Duck that resorted thither for nesting purposes had to seek fresh quarters. Some of them undoubtedly went to the Wretham Park Meres, and Thompson and Stanford Waters, while others frequented the river Little Ouse both above and below Thetford. Below the town, owing to the practical lapse of the navigation and the growing-up of the river, Wild-fowl have greatly increased in numbers. On September 6th, 1900, I counted over 200 Ducks, chiefly in broods, in less than a mile between the second and third staunches. These were chiefly Mallard, which are also fairly common on the meres, one on Langmere on August 27th, 1904, being pure white. On the same date there were about 200 Ducks on Langmere, and 100 birds, chiefly Coots, on Fowlmere; on November 5th, 1904, there were about 350 Ducks on Langmere. While the big flocks are largely composed of Mallard, there are generally a fair number of Gadwall included, and a brood or two of Garganey, which generally keep distinct, while Tufted Duck occasionally occur. On November 5th, 1904, I counted nine Swans on Fowlmere, on March 9th, 1905, twenty-one, and on April 23rd, nine. These were thought to be Whoopers by the neighbouring farmer, but none were shot. Early in the spring of 1903 there were quite 150 Gadwall on the river at Euston; in previous years the numbers had been but eight or ten. About half a dozen pairs stayed to nest, the eggs being seen. On April 13th, 1906, I got quite close to a flock of fifteen Common Sheld-duck on Langmere. There was a Shoveller's nest at Lynford in 1900, and a male and female Tufted Duck were shot at Santon Downham in 1902. On February 17th, 1906, a female Goosander was shot at Wretham.

There are still some Black Grouse on Thetford Warren—whether survivors of those turned out in 1885 I am not in a position to say—and a few broods are hatched each year. A grey hen was caught at Illington in 1899. In the 'Birds of Norfolk' it is stated that the Corncrake does not seem to breed in the "breck" district, but young hens were killed at Euston in 1901, Illington in 1902, and Thetford in 1903, while the characteristic note was heard near Fakenham church on May 27th, 1898, by the Rev. R. B. Caton, by three persons near Thetford Castle Hill on April 16th, 1897, and by myself near Thetford railway station on April 23rd, 1897.

During the decade under notice, an attempt was made to acclimatise the Great Bustard, and sixteen birds were imported in 1900. They remained at Elveden till June 1901, when all but four or five took their departure and two were almost immediately shot at Finningham. In October there were still two pairs left wandering about the district, and by July, 1903, only a single pair remained. Both this year and 1902 a nest was made in the same field in which the last indigenous Great Bustard bred, but the eggs laid on both occasions were unincubated. The experiment thus ended disastrously. Stone Curlews certainly seem on the increase in the district. On September 3rd, 1897, I received two nestlings from Santon. These I forwarded to Mr. T. Southwell, F.Z.S., who wrote that the younger might be any age from one to three or four days, and the larger a week old at least. They are now in Norwich Castle-Museum. Between February 17th and 24th, 1900, six were seen by Mrs. R. B. Caton flying across Euston Park, and eight were noticed at Cranwich on November 28th, 1900. Ringed Plovers also, have at least maintained their numbers. In addition to the Breckland breeding-places previously recorded ('Zoologist,' Nov. 1897), they have also nested in recent years on Santon Square, Santon Breck; the Spectacle Hangers, Santon Downham; Cranberry, Great Hockham; and a few have been noticed on the sandy heaths near Icklingham.

There was at least one Woodcock's nest in Fakenham Wood in 1903, for the young birds were seen in Euston Park. On

July 3rd, 1897, I saw a Common Snipe fly up from the marsh-land at Santon, and after wheeling round for some time alight on the top rail of the wooden fencing of the railway line, stop a few minutes, and then fly down into the grass. In 1903 there were between forty and fifty nests on the marshes between Little Lodge Farm, Santon Downham, and the river, and I was told that Snipe frequently perched on a lightning-struck tree close by. The Rev. R. B. Caton saw a Green Sandpiper by the river at Fakenham on June 22nd, 1905, and again on August 1st, 1906. A Common Curlew was found dead in a garden at Abbey Green, Thetford, in March, 1903, and on September 5th. 1906, I saw four on a marshy heath close by Lakenheath station (Brandon parish). Eleven Common Terns were seen fishing in the river between Fakenham and Euston on May 23rd, 1898, by the Rev. R. B. Caton. Most were in immature plumage and they seemed to secure a good many small fish. Early in January, 1906—an extraordinary time of year—an immature specimen was found dead two miles from Thetford. My final bird-note refers to a male Red-throated Diver, in winter plumage, which was shot close to Two-mile-bottom, Thetford, on February 14th, 1906. When taken from the water, four Roach dropped from its mouth, the largest about $4\frac{1}{2}$ in. long.

Fish records are few. In the early spring of 1897, after some white lead had been turned into the river at the Two-mile-bottom, a large fish was observed lying on the surface of the water. Upon being shot by a gamekeeper it was found to be a Salmon Trout of $9\frac{3}{4}$ lbs. In the last week of June, 1897, a Salmon Trout weighing 8 lb. 9 oz., was caught in one of the sluices above the flour-mill at Thetford. A specimen of the Burbolt from Thetford was presented to the British Museum in 1903 by Mr. A. Parry, and three others in 1905 by Mr. W. E. Sowels. A Pike weighing $19\frac{1}{2}$ lbs. was caught at Kilverstone in December, 1902, and is now in the possession of Mr. J. Vavasseur. A Chub weighing 6 lb. was caught at Brandon on July 4th, 1897; another $23\frac{1}{2}$ in. in length and weighing 7 lb. 2 oz. near Lakenheath staunch in November, 1904, and another weighing 6 lbs. at Brandon on March 17th, 1906.

X.

THE DISTRIBUTION OF FLINT AND BRONZE IMPLEMENTS IN NORFOLK.

By W. G. Clarke.

Read 27th January, 1907.

In order to obtain an accurate and comprehensive view of Norfolk in prehistoric times, of the distribution of population, the lines of the trackways, and the migratory movements during the Neolithic and Bronze Ages, it is a primary necessity to know where relics of the various periods have been found in the county. Many have been recorded from time to time but subsequently lost sight of; and there are hundreds of specimens in museums and private collections which are unknown except to a limited circle. These, so far as it has been possible to obtain knowledge of them, I have classified according to the scheme I put forward in last year's 'Transactions' (vol. viii. pt. ii. pp. 215-230).

While perfection is unobtainable, I may claim that the list marks a great advance on any previous one. The number of Norfolk localities given in Windle's 'Remains of the Prehistoric Age in England' (1904), is Paleolithic 5, and Bronze 6. In the 'Victoria History of the County of Norfolk' (vol. i., 1901), the numbers are Paleolithic 9, Neolithic 54, and Bronze 38. The localities given hereafter are Eolithic 1, Paleolithic 30, Neolithic (Cissbury type, 4, Early or Boulder clay type 101, Intermediate or sandy site type 100, late or polished 109),

and Bronze 71. For purposes of comparison it may be interesting to note that in a list of Suffolk localities which Mr. W. A. Dutt has compiled the totals are :—Paleolithic 38, Neolithic (Early 75, Intermediate 83, Late 78), and Bronze 30.

In Eolithic and Paleolithic times the land-surface was so different that it is impossible to make comparisons with the present. Nevertheless, with about five exceptions, all Norfolk Paleoliths have been found close to the present coast-line, by the fenland or broadland borders, or alongside the present river-valleys. Neither from Broadland nor the Fenland are there any records of Early or Intermediate Neolithic implements, the majority of which have been found in close proximity to the valleys of present streams. The greater number of records of Early Neolithic implements are from the mid and south-eastern parts of the county; but I suspect that this is because these districts have been better worked than others, and not because of the absence of such implements from other areas. The number of localities in which implements of this period have been discovered probably indicates a nomadic population, and a long occupation. Intermediate Neolithic or sandy site implements have been chiefly found in south-west Norfolk, and around Cromer, most of the localities in other parts having been recorded from isolated specimens. The only records from the Fenland are of polished or bronze implements, apparently indicating that at least in late Neolithic times, some of the fen islets were habitable. It is difficult to gather anything from the localities in which polished or bronze implements have been found, although there is apparently a preference for river-valleys, but this is not remarkable considering the extent to which the county is covered by water-courses.

In the subsequent list (for assistance in the compilation of which I have to thank many kind friends), I have first given the parish, then references to any printed record concerning the implements found therein, followed by the public museums and private collections in which specimens are now to be found. The addresses of private collectors are only given with the first reference.

I. EOLITHIC.

Norwich (Earlham), W. G. Clarke, Norwich; G. Rye, Norwich; (Eaton), Trans. Norfolk & Norwich Nat. Soc. vol. viii. pp. 217-220; W. G. Clarke; W. A. Dutt, Carlton Colville; G. Rye; (Heigham), W. G. Clarke.

II. PALÆOLITHIC.

Aylmerton, Evans' 'Ancient Stone Implements of Great Britain,' 2nd edition, p. 572.

Brisley, W. G. Clarke. Brockdish, Galpin's 'Flora of Harleston,' p. 18. Broome, Cambridge Museum of Archæology. Burston, 'Norfolk Archæology,' vol. ix. p. 363. 'Geology of Diss, Eye,' &c., p. 19.

Cringleford, 'Geology of the Country round Norwich' (Woodward), p. 145. Miller and Skertchly's 'Fenland,' p. 634. F. W. Harmer, Cringleford.

Dersingham, Dersingham School Museum.

Feltwell (Shrub Hill), Quart. Jour. Suffolk Institute, vol. i. p. 4. Quart. Jour. Geological Society, vol. xxv. p. 451-2. Evans' 'Stone Implements,' pp. 550, 568-9. 'Geology of South-Western Norfolk and Northern Cambridgeshire,' p. 97. Report of British Association, 1866. Miller and Skertchly's 'Fenland,' p. 17. British Museum 'Guide to the Antiquities of the Stone Age,' pp. 16, 21. Fritton, 'Geology of the Country round Norwich,' p. 145. Proc. Nor. Geologists' Society, vol. i. p. 109. Geological Museum, Jermyn Street, London.

Heacham, 'From Paleolith to Motor Car,' by H. Lowerison pp. 20, and 11. 'Ruskin School-Home Magazine,' 1905, pp. 62-3. Holcombe Ingleby, Sedgeford.

Markshall, 'Geology of the Country round Norwich,' p. 145. Geological Museum, London. Methwold, 'Norfolk Archæology,' vol. ix. p. 363. Middleton (Blackbury End), Lynn Museum.

Norwich (Earlham) W. G. Clarke.

Palling, A. C. Savin, Cromer.

ROUGHAM, British Museum. RUSHFORD (Snarehill), Trans. Norfolk & Norwich Nat. Soc. vol. viii. pp. 33, 221. J. Chapman, Swaffham; W. G. Clarke; A. G. Cronshey, Thetford; W. A. Dutt; F. Russell, Thetford.

SAHAM TONEY, W. G. Clarke; C. F. Newton, Saham Toney. SANTON, British Association Report, 1866. SCOULTON, W. C. Palmer, Hingham. SOUTH WOOTTON, Evans' 'Stone Implements,' p. 572. STALHAM, Add. MS. 23060, British Museum. SUTTON BRIDGE, 'Norfolk Archæology,' vol. xii. p. 320.

THETFORD (Melford Bridge), 'Norfolk Archæology,' vol. vii. p. 373. Cambridge Museum of Archæology. Norwich Museum. (Red Hill and White Hill), Quart. Jour. Geological Society, vol. xxiii. pp. 45-55, vol. xxv. pp. 449-460. 'Norfolk Archæology,' vol. vii. p. 353. Trans. Norfolk & Norwich Nat. Soc. vol. vi. pp. 23, 24, 27. Evans' 'Stone Implements,' pp. 550-6. 'Geology of parts of Cambridgeshire and Suffolk,' pp. 80, 81, 85, 86, 87, 93. 'East Anglian Handbook,' 1869, p. 58. 'Report of British Association,' 1866. Quart, Jour. Suffolk Institute, vol. i. p. 4. British Museum 'Stone Age,' Guide, pp. 16, 21. General Pitt-Rivers' 'Evolution of Culture' (1906), p. 107. Blackmore Museum, Salisbury. British Museum. Cambridge Museum of Archæology. Ipswich Museum. Norwich Museum. Moyse's Hall Museum, Bury St. Edmund's. Museum of the Scottish Society of Antiquaries, Edinburgh. J. Chapman; Dr. Allen Sturge, Nice. TOTTENHILL, Lynn Museum. H. J. Hillen, King's Lynn.

WEETING (Botany Bay), 'Geology of South-West Norfolk,' &c., pp. 49, 50. British Museum 'Stone Age' Guide, p. 9. (Bromehill), Quart. Jour. Geological Society, vol. xx. p. 449. 'Geology of South-West Norfolk,' &c., pp. 40, 94, 116. Evans' 'Stone Implements,' p. 560. British Museum 'Stone Age' Guide, p. 21. Blackmore Museum, Salisbury. Museum of the Scottish Society of Antiquaries, Edinburgh. WELLS, 'Geology of Fakenham, Wells, and Holt,' p. 36. WEST RUNTON, 'Geology of Cromer,' p. 120. Evans' 'Stone Implements,' p. 572. A. C. Savin. WILTON, Trans, Norfolk & Norwich Nat. Soc. vol. iv. p. 518. Cambridge Museum of Archæology. Norwich Museum. WYMONDHAM, W. G. Clarke; G. Rye.

III. NEOLITHIC.

(A. Cissbury Type.)

Heacham, Heacham Parish Museum. Ruskin School-Home Museum.

Great and Little Massingham. Evans' 'Stone Implements,' p. 83. Trans. Norfolk & Norwich Nat. Soc. vol. v. pp. 250-264; vol. viii. pp. 223-6. Lynn Museum. Norwich Museum. W. G. Clarke; Dr. H. Laver, 43 Head Street, Colchester; G. Rye.

Ringland, Trans. Norfolk & Norwich Nat. Soc. vol. viii. pp. 223-6. Thetford Mechanics' Institute. W. G. Clarke; G. Rye.

Weeting (Grimes' Graves), Journal of Ethnological Society of London, new series, vol. ii. pp. 419-439. Proc. Soc. of Antiquaries of Scotland, vol. viii. pp. 419-28. Evans' 'Stone Implements,' pp. 33, 34. 'Journal of the Archæological Association,' vol. viii. p. 77. 'Reliquary,' June, 1893 and 1896, vol. ii. p. 168. 'Norfolk Archæology,' vol. vii. p. 360, *et seq.* Trans. Norfolk & Norwich Nat. Soc. vol. iv. p. 518; vol. vi. pp. 25-6; vol. viii. pp. 28, 223-6. 'East Anglian Handbook,' 1877. p. 102; 1888, p. 168. British Association Report, 1879, p. 400. 'Archæologia,' vol. liv. 2nd series, p. 111. Miller and Skertchly's 'Fenland,' p. 492. British Museum 'Stone Age' Guide, pp. 79-80. British Museum. Cambridge Museum of Archæology. Geological Museum, London. Norwich Museum. Thetford Mechanics' Institute. W. G. Clarke; W. A. Dutt; R. Elliott, 161 Camberwell Road, S.E.

(B. Boulder Clay Type.)

Aldeby, Thetford Mechanics' Institute. W. G. Clarke. W. A. Dutt. Ashwellthorpe, W. G. Clarke.

Barford, W. G. Clarke. Bawburgh, W. G. Clarke. Bawdeswell, J. Rutter. Pulham St. Mary. Blofield, C. Chambers, Lowestoft. Bradeston, C. Chambers. Bowthorpe, W. G. Clarke. Brockdish, W. A. Dutt. Brundall, C. Chambers; W. G. Clarke; G. Rye. Burgh St. Peter, 'The Waveney Valley in the Stone Age,' by W. A. Dutt, Lowestoft, 1905, p. 27; W. A. Dutt.

Caistor, W. G. Clarke ; G. Rye ; G. F. Steward, Norwich. Castleacre, Ruskin School-Home Museum, Heacham. W. G. Clarke. Colney, W. G. Clarke. Costessey, W. G. Clarke. Croxton, Thetford Mechanics' Institute.

Denton, W. A. Dutt. Ditchingham, W. G. Clarke ; W. A. Dutt. Docking, Ruskin School-Home Museum, Heacham. Drayton, W. G. Clarke ; G. Rye.

Earsham, 'Waveney Valley in Stone Age,' p. 28. East Barsham, Norwich Museum. East Dereham, G. Rye. East Tuddenham, G. Rye. Easton, G. Rye. Egmere, Norwich Museum. Ellingham, 'Waveney Valley in Stone Age,' p. 29.

Fakenham, G. Rye. Felthorpe, W. G. Clarke ; G. Rye. Fundenhall, W. G. Clarke.

Geldeston, 'Waveney Valley in Stone Age,' p. 32. C. Chambers. Gillingham, 'Waveney Valley in Stone Age,' p. 33. C. Chambers. Great Massingham, G. Rye. Great Melton, W. G. Clarke. Great Ryburgh, G. Rye.

Haddiscoe, W. G. Clarke. Hales, Thetford Mechanics' Institute. W. G. Clarke. Hassingham, C. Chambers. Heacham, 'From Paleolith to Motor Car,' pp. ii. iv. v. "Ruskin School-Home Magazine," 1905, pp. 56, 63-4. Ruskin School-Home Museum, Heacham. H. J. Hillen. Heckingham, W. G. Clarke. Hellesdon, W. G Clarke. Hempton, G. Rye. Hethersett, W. G. Clarke; A. D. Euren, Norwich ; G. Rye. Hickling, Norwich Museum. Hingham, W. C. Palmer. Hockering, G. Rye. Hoe, G. Rye. Horning, G. F. Steward. Hunstanton, Ruskin School-Home Museum, Heacham.

Kelling, W. G. Clarke. Kilverstone, Thetford Mechanics' Institute. J. Rutter. Kimberley, W. G. Clarke. Kirby Bedon, W. G. Clarke. Kirby Cane, W. A. Dutt.

Little Dunham, Evans' 'Stone Implements,' p. 70. Little Melton, A. D. Euren. Little Ryburgh, G. Rye. Loddon, G. Rye.

Marlingford, W. G. Clarke. Melton Constable, G. Rye. Mulbarton, W. G. Clarke. Mundesley, G. Rye.

Needham, W. A. Dutt. North Creake, Ruskin School-Home Museum. Heacham. North Elmham, W. G. Clarke.

North Tuddenham, G. Rye. Norwich. Evans' 'Stone Implements,' p. 228. Trans. Norfolk & Norwich Nat. Soc. vol. viii. p. 228. W. G. Clarke; J. Nelson, 67 Mill Hill Road, Norwich; G. Rye; G. F. Steward.

Ormesby, W. G. Clarke. Overstrand, G. Rye.

Panxworth, W. G. Clarke. Pensthorpe, G. Rye. Postwick, W. G. Clarke; G. Rye.

Ringland, Trans. Norfolk & Norwich Nat. Soc. vol. viii. p. 227. Thetford Mechanics' Institute. W. G. Clarke; Mr. and Mrs. W. A. Dutt; G. Rye. Ringstead, Ruskin School-Home Museum, Heacham. Rushford, W. G. Clarke; W. A. Dutt.

Salhouse, W. G. Clarke. Santon, W. G. Clarke; W. A. Dutt; G. Rye; G. F. Steward. Scarning, Rev. A. Jessopp, Scarning. Scratby, W. G. Clarke. Sedgeford, Ruskin School-Home Museum, Heacham. Sheringham, W. G. Clarke. Sidestrand, G. Rye. Snettisham, Ruskin School-Home Museum, Heacham. Southbergh, W. C. Palmer. South Wootton, Lynn Museum. Sporle, G. Rye. Stockton, W. G. Clarke. Strumpshaw, C. Chambers. Swaffham, W. G. Clarke; G. Rye; G. F. Steward. Swanington, W. G. Clarke; G. Rye. Swanton Novers, W. G. Clarke.

Tacolnestone, G. F. Steward. Tasburgh, W. G. Clarke; G. Rye. Thorpe St. Andrew, W. G. Clarke. Tivetshall St. Margaret, G. Rye.

Wendling, W. G. Clarke. West Harling, W. G. Clarke. Weybourne, W. G. Clarke; G. Rye. Whitlingham, F. N. Haward. Norwich. Wretham, W. G. Clarke; W. A. Dutt. Wymondham, W. G. Clarke; W. A. Dutt.

(C. Sandy Site Type.)

Aldeby, 'Geology of the Country Round Norwich,' p. 145. Anmer, W. G. Clarke. Attleborough, Proc. of Arch. Institute, 1847, p. 25. Evans' 'Stone Implements,' p. 390. Aylsham, Evans' 'Stone Implements,' p. 381. A. C. Savin. Beechamwell, Catalogue of Plowright's Collection, 1905. Rev. R. C. Nightingale, Beechamwell. Bergh Apton,

Norfolk Archæology, vol. v. pp. 180-4. British Museum. Bramerton, Norwich Museum. Bressingham, Catalogue of Canon Manning's (Diss) Antiquities, 1898. Brettenham, P. R. Clarke, 31 Glebe Road, Norwich. Bridgham, W. G. Clarke ; Dr. W. T. Newton, 36 King Square, E.C. Broome, 'Waveney Valley in the Stone Age,' pp. 19, 20, 21. Trans. Norfolk & Norwich Nat. Soc. vol. viii. p. 230. W. G. Clarke ; Mr. and Mrs. W. A. Dutt. Burston, Mr. Abon, Burston.

Caldecot, The Rev. R. C. Nightingale ; T. A. Barton. Carbrooke, Add. MS. 23054, British Museum. Catfield, W. A. Dutt. Cranwich, Cambridge Museum of Archæology, S. G. Causton, Field Barn, Cranwich ; Dr. W. T. Newton. Cromer, Norfolk Archæology, vol. viii. p. 336. W. G. Clarke ; Sir Samuel Hoare, Bart., Sidestrand ; A. C. Savin. Croxton, Cambridge Museum of Archæology. W. G. Clarke ; Dr. W. T. Newton.

Diss, Norfolk Archæology, vol. iv. p. 311. Norwich Museum. Ditchingham, W. A. Dutt. Drayton, Norfolk Archæology, vol. ix. p. 368.

East Beckham, J. Cox. Gresham. East Wretham, Trans. Norfolk & Norwich Nat. Soc. vol. viii. p. 26. Thetford Mechanics' Institute. W. G. Clarke ; W. A. Dutt. East Harling, Cambridge Museum of Archæology. Dr. W. T. Newton. Edgefield, 'Norfolk Archæology,' vol. iii. pp. 237-8.

Felmingham, W. G. Clarke. Feltwell, Evans' 'Stone Implements,' pp. 96, 174, 390. Cambridge Museum of Archæology. Dr. W. T. Newton. Frettenham, Arch. Ass. Journal, vol. iv. p. 153. Fring, Trans. Norfolk & Norwich Nat. Soc. vol. viii. p. 29. W. G. Clarke.

Garboldisham, Dr. W. T. Newton. Gaytonthorpe, Lynn Museum. Geldeston, H. C. H. Gillett, Brampton, *in litt.* Great Bircham, Ruskin School-Home, Heacham. Great Hockham, Dr. W. T. Newton. Gresham, J. Cox ; A. C. Savin.

Happisburgh, W. A. Dutt. Harleston, 'Waveney Valley in Stone Age,' p. 33. F. W. Galpin's 'Flora of Harleston,' p. 18. Harpley, Trans. Norfolk & Norwich Nat.

Soc. vol. viii. p. 230. Ruskin School-Home. W. A. Dutt. Heacham, 'From Palæolith to Motor Car,' by H. Lowerison, 1906, pp. 2, 4, 5. 'Ruskin School-Home Magazine,' 1905, pp. 56, 63-4. Norwich Museum. Ruskin School-Home. H. J. Hillen. Hellesdon, Trans. Norfolk & Norwich Nat. Soc. vol. v. p. 569. Hockwold, Dr. W. T. Newton. Holkham, Ruskin School-Home. Hoveton St. John, W. A. Dutt. Hunstanton, H. le Strange, Hunstanton.

Ickburgh, Dr. W. T. Newton.

Kenninghall, A. B. Smith, Kenninghall. Kilverstone, Cambridge Museum of Archæology. King's Lynn, Lynn Museum.

Little Massingham, Norwich Museum. Little Snoring, D. Sayer, Little Snoring. Lynford, Cambridge Museum of Archæology. W. G. Clarke; Dr. W. T. Newton.

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XI.

THE CRUSTACEA OF THE EAST NORFOLK RIVERS.

By Robert Gurney, B.A.

Read 26th February, 1907.

In my account of the Crustacea of East Norfolk, published in our Transactions in 1904, I concerned myself more particularly with the fresh-water forms, though a certain number of species were included which had been met with in brackish water. It was evident that much fuller information was required concerning the fauna of the rivers, particularly of those parts of them which are subject to tidal influence. I have, therefore, when opportunity has offered, endeavoured to make a beginning in this direction. The results, incomplete as they are, seem to me of sufficient interest to communicate to you now. The difficulties to be met in studying the fauna of the tidal regions of the rivers are naturally very much greater than those encountered in studying their upper reaches and the Broads. These difficulties are partly practical and partly theoretical. The practical difficulties are due to the fact that one has to deal more with Crustacea of a higher order, more active and more difficult to find. I have tried a variety of methods, using, in the first instance, hand nets with large and small mesh. The most active species, such as Palæmonetes, have been caught in traps made on the principle of a crab pot baited with bacon, and let down in the river. The sedentary species of Isopoda and Amphipoda must be searched for very carefully on submerged wooden posts, under stones and in mud. What I call the theoretical diffi-

culties are due to the fact that it is impossible to distinguish localities as fresh- or brackish-water without regard to the state of the tide, since, at any given spot one may find the water fresh at one time and salt at another. Also, though one can distinguish certain species which are decidedly fresh-water or marine, others are difficult to place, and also it is often impossible to say whether a species taken in water of a certain salinity is really capable of prolonged exposure to such a medium or is only submitting to it for a time.

The following remarks deal chiefly with the River Bure and its tributaries the Ant and Thurne River, but observations made and species found on the Yare and Waveney will also be mentioned. I intend also to mention one or two species which are not Crustacea.

The three rivers Bure, Yare and Waveney have a common opening to the sea, and have a general similarity in their slight fall and velocity and in their tidal nature. In the Yare and Waveney the deeper channel, and the absence of considerable Broads, are probably the reasons why the tide is greater in these two rivers than it is in the Bure. In the Yare the tidal oscillation is very considerable even at Norwich, and in the Waveney there is a rise and fall in Oulton Broad of about 18 inches. In the Bure, on the other hand, the oscillation diminishes very rapidly above Acle, and is quite insignificant above Horning.

There is, however, a very necessary distinction to be made between tidal oscillation and the range of salt water. The range of salt water up the Yare and Bure, in spite of the difference in the tidal oscillation, is very much the same. That is to say, in ordinary circumstances, I believe that salt water cannot be traced further up the Yare than Cantley—about 12 miles from Yarmouth. In the Waveney it certainly reaches as far as Oulton Broad, but probably not much further. In the Bure, in normal circumstances, there is no "Chemical Tide," if I may call it so, further than Acle Bridge, which is also about 12 miles from Yarmouth. Even at the period of Spring tides, and those among the highest of the year (July 4-10th, 1906), there was no difference appreciable

by rough chemical analysis between the salinity at high and low water at Acle.

On the other hand, there are sometimes tides of exceptional height which drive the salt water up the river much further than Acle, and it is with the fauna of the river as influenced by these changing conditions that I propose to deal. The Tides, from both the Chemical and Physical standpoint, will, I hope, be dealt with fully at some future date.

For the purposes of this paper I propose to divide the River Bure into three sections as follows :—

(1) From Yarmouth to Six-mile House.
(2) From Six-Mile House to Acle Bridge.
(3) From Acle Bridge upwards, including the Ant and Thurne Rivers.

No one section can, of course, be really divided sharply from the succeeding one ; but I think this method will be found convenient and satisfactory.

Section I.—Yarmouth to Six-mile House.

This section of the river may be considered as purely estuarine in character. The river is here a turbid stream with a very strong current both during flood and ebb. The banks are covered with the short grasses characteristic of salt marshes, and with abundance of the beautiful *Aster tripolium*. At low water the falling river lays bare considerable stretches of sticky mud. The fauna is generally scanty and of a decidedly marine type, as the following collections will show.

On the other hand, just as the salt water sometimes reaches far up the river, so there are times when the water is fresh right down to the river mouth. I have never met with quite such conditions myself, but I have seen a collection made by Mr. Eustace Gurney in April, 1901, at the Yacht Quay at Yarmouth which contained solely fresh-water species. At all times the floating fauna in this part of the river is exceedingly scanty. The water is thick with floating vegetable debris and mud and generally contains very few individuals

of any species. Probably the bottom fauna is equally poor, owing to the strong scour of the tide leaving no soft mud and allowing no vegetation to grow. Here are three collections which fairly illustrate the conditions at the mouth of the Bure. All three were made at the Yacht Quay.

(1) April 27th, 1901. Low water.

Simocephalus vetulus.
Ceriodaphnia quadrangula.
Bosmina longirostris.
Chydorus sphæricus.
Cyclops strenuus.
,, leuckarti.
Diaptomus vulgaris.
Eurytemora lacinulata.
Tachidius littoralis.
Ectinosoma sp.

(2) April 28th, 1903. Three-quarter ebb.
(Chlorine 416.3 grs. per gall.).

Daphnia longispina.
Eurytemora lacinulata.
Tachidius littoralis.
Laophonte littorale.
Stenhelia hispida.
Neomysis vulgaris.

(3) June 8th, 1903. Flowing tide.
(Chlorine 862.8 grs. per gall.).

Cyclopina littoralis.
Eurytemora affinis.
Centropages hamatus.
Temora longicornis.
Parapontella brevicornis.
Acartia longiremis.
Gnathia maxillaris.
Carcinus maenas.
Crangon vulgaris.

Of course these collections do not pretend to be any more than samples indicating the general composition of the fauna

at the time. They show that the fauna is mainly of a marine type irrespective of the state of the tide, but that fresh-water species may be brought down on the ebb, though they do not form a normal component of the fauna. I suppose that many individuals of the fresh-water floating species must be carried into salt water and killed, for it is not uncommon to find dead specimens of fresh-water species in a collection. Such a destruction, if it occurs, would not however, be of any great importance, since I believe that the rivers do not have what may be called an indigenous fauna of floating species. I believe that the stock is maintained by constant influx from breeding centres in the still water of the Broads.

Proceeding further up the river one finds the fresh-water element more in evidence, collections containing solely marine species being the exception. Here are some examples :—

(1) Just above Yarmouth.
June 21st, 1906. 5.15 p.m. ebb.

Ceriodaphnia pulchella.
Bosmina longirostris.
Chydorus sphæricus.
Cyclops leuckarti.
Tachidius brevicornis.
Loxoconcha viridis.

(2) Between 6 and 5-mile House.
April 27th, 1903. High water.

Bosmina longirostris.
Simocephalus vetulus.
Chydorus sphæricus.
Cyclops strenuus.
,, leuckarti.
Eurytemora lacinulata.
,, affinis.
Tachidius littoralis.
,, brevicornis.
Corophium grossipes.
Heterotanais gurneyi.
Neomysis vulgaris.

These collections do not give quite a fair idea of the fauna, since one of them (No. 1) was taken with a townet and thus did not contain species which were almost certainly present, for example, *Neomysis vulgaris* and *Palæmonetes varians*.

The following is a list of species taken at a point between Runham and Stokesby on August 19th, 1906, during a high salt tide.

Noctiluca miliaris.
Hormiphora sp.
Acartia discaudata.
Centropages hamatus.
Eurytemora affinis.
Balanus nauplii.
Sphæroma rugicauda.
Gnathia maxillaris.
Leptocheirus sp.
Macromysis flexuosa.
Neomysis vulgaris.
Macropsis slabberi.
Palæmonetes varians.

Of course such an exclusively marine fauna is exceptional in the upper parts of this section. An additional proof of this is that the fauna of the ditches adjoining the river behind the river walls is exclusively fresh-water. In the truly estuarine parts of the river the salt water makes its influence felt even upon the surrounding marshes.

Section II.—Six-mile House to Acle Bridge.

This Section, which covers a stretch of about five miles of river, is perhaps the most interesting of all. It is essentially a region of transition from salt to fresh water, for, whereas at the one end the estuarine features can still be traced, at the other end one finds oneself even more distinctly within the fresh-water sphere. From about Stokesby upwards one finds Reeds and Sedges along the bank, and sometimes, in sheltered nooks, a good deal of Potamogeton and other weeds. In normal circumstances the water at Acle Bridge, while

constantly of a somewhat higher salinity than that of the fresh-water Broads, is not subject to distinct fluctuations of salinity dependent upon the tides. Generally, in this section, one expects to find the floating fauna of a prevailing fresh-water type though with a small proportion of Algal constituents, while there is also a rather extensive sedentary population, subject of course to variation, comprising species commonly considered as brackish or marine. The water has here lost the turbid character of the lower reaches which seems inimical to life. Of sixteen series of collections made within this area eleven may be said to contain predominant fresh-water forms and five salt or brackish species. I give here three lists of species representing these opposite conditions. An analysis of the relations of the species one with the other will be given below.

(1) July 6th, 7th, 1906.
Between Muckfleet and Acle Bridge.
Chlorine 7.34 gr. per gall.

Nereis diversicolor.
Cordylophora lacustris.
Sida crystallina.
Diaphanosoma brachyurum.
Ceriodaphnia quadrangula.
Simocephalus vetulus.
Schapholeberis mucronata.
Bosmina longirostris.
Ilyocryptus agilis.
Eurycercus lamellatus.
Lynceus affinis.
,, quadrangularis.
Chydorus sphaericus.
Cyclops viridis.
,, leuckarti.
,, serrulatus.
Tachidius littoralis.
Laophonte mohammed.
Eurytemora lacinulata.

Cytheridea torosa.
Gammarus duebeni.
Melita pellucida.
Microdeudopus versiculatus.
Corophium grossipes.
Heterotanais gurneyi.
Cyathura carinata.
Palæmonetes varians.

(2) August 18th, 1905.
Between Runham and Stokesby

Noctiluca miliaris.
Acartia longiremis.
Centropages hamatus.
Eurytemora affinis.
Balanus nauplii.
Leptocheirus, sp.
Sphæroma rugicauda.
Gnathia maxillaris.
Macromysis flexuosa.
Neomysis vulgaris.
Macropsis slabberi.
Palæmonetes varians.

(3) Acle Bridge. September 5th, 1905.
Chlorine 620.3–450.6.

Canthocamptus palustris.
Tachidius littoralis.
Euterpe acutifrons.
Eurytemora affinis.
Gammarus duebeni.
Corophium grossipes.
Sphæroma rugicauda.
Neomysis vulgaris.
Macropsis slabberi.
Palæmonetes varians.

The first list is particularly interesting, inasmuch as the collections were made at a time when, in spite of spring tides, the water was fresh for a long period, and when no change of

salinity was perceptible to rough analysis at high and low water. As a matter of fact, I believe the water had been fresh all through the summer. Yet, in spite of that one finds, in addition to the fresh-water species, several species which are generally found in brackish or salt water. On the other hand, when (Nos. 2 and 3) the water was salt no fresh-water species were to be found. The fauna in the neighbourhood of Acle is a good deal richer, in ordinary conditions, than it is below. In the patches of *Potamogeton pectinatum* growing in certain places along the shores between Muckfleet and Acle there is an abundance of Crustacea.

THE MUCKFLEET.

The Muckfleet Dike, as its name implies, was once a broad shallow dike leading freely from Ormesby, Rollesby and Filby Broads into the river about a mile below Acle Bridge. It is now a very narrow dike shut off from the river by sluice gates, its function being to conduct water from the river to the Broads whence it is drawn off for the supply of Yarmouth by the Ormesby Waterworks.

The only part of it with which we are concerned is the part nearest the river, where it widens out into a large pool with a considerable amount of vegetation consisting of *Myriophyllum*, *Ranunculus aquatilis*, *Potamogeton pectinatum* and a little *Ulva*. The depth of water varies considerably according as the supply from the river is shut off by the sluice gates or not. The composition of the water in the Muckfleet is thus largely a matter of human regulation, but, at its river end, it is subject to great fluctuations of salinity, similar to those in the river. During high tides in the river the water becomes, by slow infiltration, highly saline, while at other times, when opportunity offers, fresh water is drawn in, and also, no doubt, there is a considerable dilution caused by reflux of water from the Broads. The fauna varies with these changes. It does not appear that floating forms are drawn in from the river, so that marine Calanoids are never found; but fresh-water Plankton species often occur, and

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
1. Coelopiiora lacustris		—	—	+	+	—	—	—	—	—	+	—	—	+	+	+	+		+	—	—	—	+	+	+	—	—
2. Daphnia cucullata	—	—	—	+	+	+	+	—	+	—	+	+	+	+	—	—	—	—	—	+	—	+	+	—	—	—	—
3. Ceriodaphnia reticulata	—	—		—	+	—	+	+	—	+	+	+	—	+	+	+	—	—	—	—	—	—	+	—	+	—	+
4. ,, pulchella	+	+	—		+	+	+	—	+	—	+	+	+	+	+	+	+	—	+	+	—	+	+	+	+	—	—
5. Simocephalus vetulus	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+	+	—	+	+	—	+	+	+	+	—	+
6. Bosmina longirostris	—	+	—	+	+		+	—	+	—	+	+	+	+		+	—	+	—	+	—	+	+	—	+	—	—
7. Eurycercus lamellatus	—	+	+	+	+	+		+	+	+	+	+	+	+	+	+	—		—	+	—	—	+	—	+	—	+
8. Acroperus harpae	—	—	+	—	+	—	+			+	+	+	—	+	+	+	—	—	—	—	—	—	+	—	+	—	—
9. Lynceus rectangulus		+		+	+	+	+	—		—	+	+	+	+	+	+	—	+	—	+	—	+	+	—	—	—	—
10. Pleuroxus aduncus		—	+	—	+	—	+	+	—		+	+		+	+	+	—	—	—	—	—	—	+	—	+	—	+
11. Chydorus sphaericus	+	+	+	+	+	+	+	+	+	+		+	+	+	+	+	+	—	+	+	—	+	+	+	+	—	+
12. Cyclops strenuus	—	+	+	+	+	+	+	+	+	+	+		+	+	+	+	—	—	—	+	—	+	+	—	+	—	+
13. ,, lubbocki		+		+	+	+	+	—	+	—	+	+		+	+	+	—	+		+	+	+	+	—	+	+	
14. ,, viridis	+	+	+	+	+	+	+	+	+	+	+	+	+		+	+	+	+	+	+	—	+	+	+	+	—	+
15. ,, leuckarti	+	—	+	+	+	—	+	+	+	+	+	+	+	+		+	+	—	+	+	—	—	+	+	+	—	+
16. ,, serrulatus	+		+	+	+	+	+	+	+	+	+	+	+	+	+		+	+	+	+	+	+	+	+	+	+	+
17. ,, prasinus	+	—		+	+	—		—			+		—	+	+	+			+		+	+		+	+	—	—
18. ,, aequoreus		—	—	—		+			+			—	+	+		+	—		—	+	+	—	+	—	—	—	—
19. Thersites gasterostei	+	—	—	+	+	—			—	—	+	—		+	+	+	+				—		+	+	+	—	—
20. Tachidius littoralis		+		+	+	+	+	—	+	—	+	+	+	+	+	+	—	+			+	+	+	—	+	+	—
21. Laophonte mohammed		—		—	—	+			+	—		—	+	+		+	—	+		+			+		+	—	—
22. Eurytemora affinis		+		+	+	+	+		+		+	+	+	+		+	—		—	+	—		+	—		—	—
23. ,, lacinulata	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+		+	+
24. Argulus foliaceus	+	—	—	+	+	—				—	+		—	+	+	+	+		+	—	—	—	+		+	—	—
25. Gammarus duebeni	+	—	+	+	+	+	+	+	—	+	+	+		+	+	+	+		+	+	+	+	+	+		+	+
26. Neomysis vulgaris	—				—			—					+			+				+	+	—	+		+		
27. Simocephalus exspinosus	—	—	+	—	+	—	+	+	—	+	—	+	—	+	+	+	—			—	—	—	+	—	+	—	

TABLE SHOWING THE FAUNA OF THE MUCKFLEET DIKE.

brackish Copepoda sometimes find their way in. The following collections show the nature of the fauna. I also give a table showing the whole list of species hitherto found here and the species with which each may associate.

In this table the species are numbered 1–27 and the numbers are repeated at the heads of the columns so that each has a line and a column to itself. When analysing any collection a cross is put in the column corresponding to each species opposite the names of the other species in the collection. In this way one arrives at a statement of all the species with which any one has been found associated. Taking the column corresponding to any species the associates of it can be read off by reference to the crosses. The table shows that there is a rather more complete mixing of fresh-water species with brackish species than obtains as a rule in the river. I attribute this to the favourable conditions of stillness and vegetation somewhat counterbalancing the effect of salinity. Still, it can also be seen that the fauna was relatively poorer during periods of salt water than when the water was fresh.

The two collections given below show that there is normally a fresh-water fauna, modified by the presence of *Gammarus duebeni*, which indicates a salinity rather higher than that of pure fresh water ; but that, during periods when the salinity rises to a high point, the fresh-water fauna becomes poorer and brackish species appear in addition.

(1) September 23rd, 1903.
Chlorine 235 grs. per gallon.

Bosmina longirostris.
Lynceus rectangulus.
Eurytemora lacinulata.
Cyclops bicuspidatus.
,, var. lubbockii.
,, viridis.
,, serrulatus.
,, æquoreus.
Tachidius littoralis.
Laophonte mohammed.
Gammarus duebeni.

(2) July 5th, 1906.
Water fresh.

CERIODAPHNIA PULCHELLA.
SIMOCEPHALUS VETULUS.
CHYDORUS SPHERICUS.
EURYTEMORA LACINULATA
CYCLOPS LEUCKARTI.
,, VIRIDIS.
,, SERRULATUS.
,, PRASINUS.
THERSITES GASTEROSTEI.
ARGULUS FOLIACEUS.
GAMMARUS DUEBENI.
CORDYLOPHORA LACUSTRIS.

SECTION III.—ABOVE ACLE BRIDGE.

Above Acle Bridge it is unnecessary to deal with the river in sections. Beyond this point the influence of salt water is, as a rule, almost negligeable so far as concerns the Bure and Ant. Below South Walsham the floating fauna is generally deficient with regard to certain species characteristic of pure fresh water, *e.g.*, *Daphnia cucullata*—and one rarely finds any considerable quantity of floating *Algæ* and *Diatoms*. Also such species as *Eurytemora affinis* and *Tachidius littoralis* are generally to be found. Up to this point it is also possible to find occasionally species which show an even more distinct marine origin : for I have found, nearly opposite South Walsham Dike, *Corophium grossipes*, *Heterotanais gurneyi*, and *Palæmonetes varians*. Still, the presence of these species indicates only their own adaptability and not salt-water conditions. So far as my own observations go this is the normal limit of the range of *Eurytemora affinis* and *Tachidius littoralis*, which are the most adaptable of the brackish Copepoda. Stragglers are sometimes taken even further up, both having occurred in fresh water in South Walsham and Ranworth Broads and at Ludham Bridge. *Eurytemora affinis* has actually been caught in Barton and Sutton Broads ;

but such specimens are rather to be considered as comparable to the migratory birds which occasionally straggle to our islands outside their ordinary range.

On the other hand, when exceptionally high tides bring salt water up the river, such salt water may reach up beyond this point and up the Ant. Unfortunately I have never been up the Bure at such times, so cannot say how far the salt can be traced in that direction, but I know that a rise of salinity may be detected, in these circumstances, as far as Barton and Sutton Broads. The rise of salinity at Sutton may amount to about 3 grs. per gallon. But even in circumstances of this kind it does not appear that marine floating species extend much further than Thurne Mouth. For instance, on July 13th, 1903, when several marine Calanoids and living Ctenophores (*Hormiphora*) were found at Thurne Mouth, the fauna at Ludham Bridge and in South Walsham Broad, though more scanty than usual, was of the usual type, with the exception that *Neomysis vulgaris* occurred at Ludham Bridge. I have been told several times that "Brown Shrimps" (*Crangon vulgaris*) are to be taken at Ludham Bridge on such occasions, but I have failed entirely to find them myself, there or anywhere above Yarmouth, and have offered a reward for them in vain. It is quite possible that they do occur; but I think that such statements may really refer to *Palæmonetes varians*.

So far as concerns the Thurne River, I think the same holds good. That is to say, its fauna is only quite exceptionally affected by salt water from the sea. On the other hand the salinity in this river differs from that in the Bure in that it increases from the mouth upwards owing to water of high salinity flowing down from Hickling Broad and Horsey Mere where there must be salt springs. The result is that the fauna is comparatively scanty, and such species as *Eurytemora affinis* and *Tachidius littoralis* are found throughout its course and in the Broads themselves. *Neomysis vulgaris* and *Gammarus duebeni* do not, I believe, ordinarily occur in the river itself below Potter Heigham, though it is possible that they have been overlooked, but both are to be found in

Hickling Broad and in Horsey Mere where the salinity is highest. *Palæmonetes varians* is to be found at Potter Heigham, but has not been taken further up. There seems to be no reason why it should not occur also in the Broads themselves since, in a trap set in Heigham Sounds on June 8th, 1906, a single specimen of *Palæmon squilla* was caught, together with a specimen of *Hydrophilus piceus*. *Corophium grossipes* also occurs in Heigham Sounds in colonies of Cordylophora, and is probably to be found all along the river from Candle Dike downwards, wherever Cordylophora occurs.

The Yare and the Waveney.

So far as concerns their Crustacean Fauna the Yare and Waveney resemble the Bure very closely, but, from lack of extended observations, I cannot deal with them in detail.

So far as my experience goes, it appears that the floating marine species do not reach, as a rule, even as far as Reedham on the Yare or St. Olaves on the Waveney. The plankton of the rivers above those points consists almost exclusively of fresh-water species. The conditions at Cantley—about 12 miles from Yarmouth—seem to resemble those at Acle on the Bure. That is to say, the fauna consists of fresh-water species with which are associated certain brackish-water species capable of adapting themselves to fresh water.

In the Waveney the subject is somewhat complicated by Oulton Broad. There is a considerable influx of salt water into the Broad through Mutford Lock, since boats come through the lock on high water from Lake Lothing. The effect varies according to the traffic, but it may be so great that Oulton Broad may become, so far as concerns its Crustacean fauna, merely an extension of Lake Lothing. Some of the salt water no doubt finds its way into the Waveney and so tends to cause a uniform high salinity from this point downwards.

Lower down both rivers, at Berney Arms and by Burgh Castle respectively, there is a rich sedentary estuarine fauna. Some of the species common here are also found abundantly

in pools on the adjoining marshes. Near Burgh Castle there are a number of such pools dug out of clay, each containing a brackish fauna somewhat different from the next one. For instance, of three pools, one contained only *Neomysis vulgaris*, a second abundance of *Gammarus duebeni* and a few Neomysis, while a third contained a mixed fauna including *Jaera marina*, *Idotea viridis* and *Delavalia palustris* besides quantities of the little Mollusc *Hydrobia ulvæ*.

CONCLUSIONS.

In considering the Crustacean fauna of these rivers one's attention is naturally attracted first to the Tides as the factor chiefly affecting the distribution of the species. From what has been said it appears that, in the Bure, the tidal wave, the influx of salt water, and the distribution of the Crustacea are three things having little correspondence. The tidal wave is a thing by itself, reaching far up the river and accompanied by the tidal stream, but having no influence whatever on the fauna. The tidal stream has some influence owing to its violence in the lower reaches. But it is the range of the salt water which is the really significant element in the tidal phenomena. This range I have stated to be practically limited by Acle Bridge, but probably accurate chemical analysis would be able to trace changes of salinity higher up. However, assuming my statement to be correct, the range of salt water does not strictly correspond to the range of certain Crustacea which are generally supposed to be dependent on water of high salinity. Many species extend far beyond this point, into completely fresh water. So that one might say that, roughly speaking, brackish water reaches to Acle, the brackish-water species of Crustacea to Ant Mouth, and the tidal wave to Wroxham Bridge.

The influence of the current is a physical one, largely indirect, since a strong stream in a narrow channel scours away the soft bottom mud which is the habitat of many species, and checks the growth of vegetation upon which

others are dependent. The influence of the salt is mainly a direct physiological one, and must be felt, in a greater or less degree, by all species exposed to it. It is also a factor which is capable of accurate estimation, so that one is tempted to lay greater stress upon its importance than is, perhaps, really justifiable.

Speaking now solely of the stretch of the Bure from Thurne Mouth downwards, I believe that there is no indigenous floating fauna, whether fresh or salt. As a general rule townet collections, though sometimes producing a fair diversity of species, are remarkable for the paucity of individuals. The number of individuals taken diminishes rapidly below Acle, and at the Yacht Quay, where the water is thick with mud and larger debris, townet collections may be almost blank.

It seems most probable that any fresh-water species taken in the townet are derived from the Broads or from the upper, relatively still, reaches of the river. If their numbers were not constantly recruited from above they would speedily die out, not solely by reason of a higher salinity or speed of current, but because the conditions of life are unstable and continually varying. Certain species, such as *Daphnia cucullata*, are probably killed by a very slight trace of salt, but others, such as *Bosmina longirostris*, are certainly capable of maintaining themselves in water of a high salinity. The latter is found in Hickling Broad where the salinity is high (about 70 grains of Chlorine per gallon) ; but it maintains itself with difficulty, and is found only in small numbers. Hickling Broad is rather a useful comparison in cases of this kind ; for here, and in Horsey Mere, where the conditions of life appear to be favourable except for the high salinity, certain species of fresh-water animals are found which are absent from the river in water of equal salinity : so that their absence from the river must be due to other causes, such as current or fluctuations of salinity.

The same remarks apply in a lesser degree to the more sedentary fresh-water species, such as the *Cyclopidæ* and *Harpacticidæ*. Of the former some are often found living in

water of high salinity if the locality is suitable in other respects; but the *Harpacticidæ* appear to be quite intolerant of river conditions. The scarcity of fresh-water Copepoda in the part of the river in question is probably due to scarcity of vegetation, owing mainly to the speed of current, and not, in the first instance, to the salinity.

But if there is no established floating fresh-water river fauna, so there is no established floating marine fauna. Marine Calanoids, when they are found, are almost always few in individuals, and nearly all the individuals are mature.

The actual fauna of the river in this region therefore consists of a floating immigrant population, either fresh-water or marine in origin, and a sedentary resident community. The residents are generally of a marine type. They constitute the "Brackish-water" fauna, but include several species not usually considered to fall under that head.

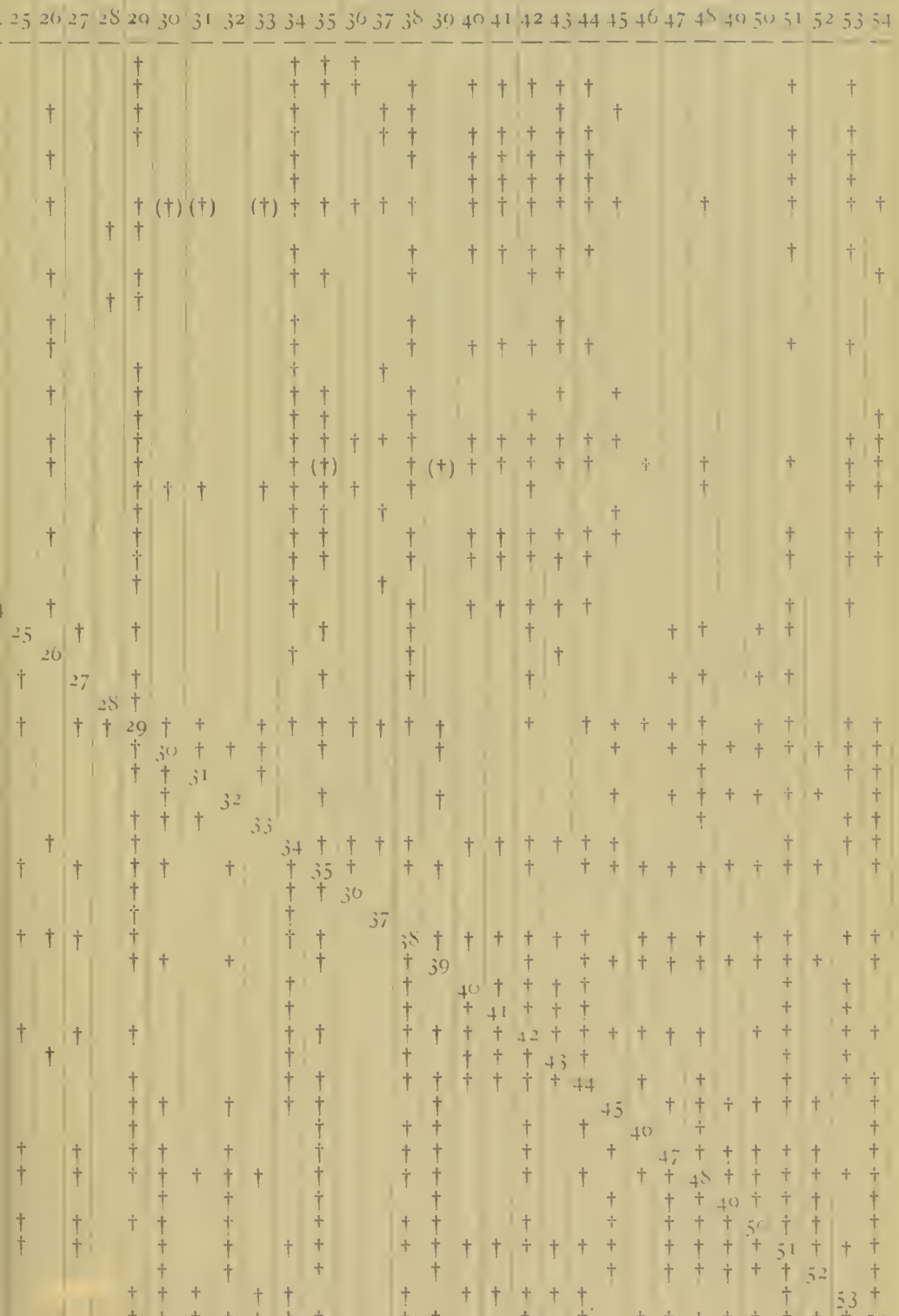
Whereas the really marine and fresh-water species do not mix, except by rare accident, these brackish species have a range which leads them to associate almost indifferently with either group.

The associations of the species one with another is made clearer by the table given here (table 2) which is constructed in the same way as table 1. It gives all the species taken in the stretch of river between Six-mile House and Acle Bridge in a number of collections made at different times. It must be remembered that the collections were always qualitative and never quantitative so that the occurrence of a single individual of any species has the same value in the table as its occurrence in numbers. Still, in spite of this source of error, the table does show in a fairly satisfactory manner the kind of association one may find in this region. It will be seen that the fresh-water Cladocera and the marine Copepoda do not mix, whereas both occur in company with certain brackish Copepods and several Malacostraca of a marine type. Column No. 7 (*Bosmina longirostris*) is a good example to take, since it is one of the commonest fresh-water species, entirely planktonic, and so a good indication of the limits of the fresh-water fauna. The crosses in brackets indicate dead

BRITISH MUSEUM
NATURAL HISTORY

TABLE II.—SHOWING OF SPECIES ASSOCIATIONS IN 17 C

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1. Daphnia longispina		†					†									†	†		†
2. Simocephalus vetulus	†	2		†	†	†	†		†				†				†	†	†
3. Ceriodaphnia pulchella			3	†	†		†			†		†	†	†	†		†	†	
4. ,, quadrangula		†	†	4	†	†	†		†				†	†			†	†	
5. Scapholeberis mucronata		†	†	†	5	†	†		†	†		†	†		†		†	†	
6. Diaphanosoma brachyurum		†		†	†	6	†		†				†				†	†	
7. Bosmina longirostris	†	†	†	†	†	†	7		†	†		†	†	†	†	†	†	†	†
8. Ilyocryptus agilis								8			†								
9. Eurycercus lamellatus		†		†	†	†	†		9				†					†	
10 Acroperus harpae			†		†		†			10		†	†		†	†	†	†	†
11. Lynceus quadrangularis								†			11								†
12 ,, rectangulus			†		†		†			†		12	†		†	†		†	
13. ,, affinis		†	†	†	†	†	†		†	†		†	13		†		†	†	
14. Pleuroxus trigonellus			†	†			†			†				14					
15. ,, aduncus			†		†		†			†		†	†		15		†	†	
16. Chydorus ovalis							†			†						16	†		†
17. ,, sphaericus	†	†	†	†	†	†	†		†	†		†	†	†	†	†	17	†	†
18. Sida crystallina		†	†	†	†	†	†		†	†		†	†		†		†	18	
19. Cyclops strenuus	†	†					†			†	†					†	†		19
20. ,, vicinus			†	†			†							†	†		†		
21. ,, viridis		†	†	†	†	†	†		†	†			†		†	†	†	†	†
22. ,, leuckarti		†		†	†	†	†		†	†			†			†	†	†	†
23. ,, hyalinus			†	†			†							†					
24. ,, serrulatus		†	†	†	†	†	†		†	†		†	†	†	†		†	†	
25. Canthocamptus palustris																			
26. Nannopus palustris			†		†		†			†			†		†		†	†	
27. Euterpe acutifrons																			
28. Laophonte mohammed								†			†								
29. Tachidius littoralis	†	†	†	†			†	†			†			†	†	†	†	(†)	†
30. Centropages hamatus							(†)												†
31. Temora longicornis							(†)												†
32. Acartia longiremis																			
33. Cyclopina sp.							(†)												†
34. Eurytemora lacinulata	†	‡	†	†	†	†	†		†	†		†	†	†	†	†	†	†	†
35. ,, affinis	†	†	†				†			†					†	†	†	(†)	†
36. Diaptomus vulgaris	†	†					†										†		†
37. ,, gracilis			†	†			†							†					
38. Gammarus duebeni		†	†	†	†	†	†		†	†		†	†		†	†	†	†	†
39. Leptocheirus sp.																		(†)	
40. Melita pellucida		†		†	†	†	†		†				‡				†	†	
41. Microdeutopus versiculatus		†		†	†	†	†		†				†				†	†	
42. Corophium grossipes		†		†	†	†	†		†	†			†			†	†	†	†
43. Heterotanais guineyi		†	†	†	†	†	†		†	†		†	†		†		†	†	
44. Cyathura carinata		†		†	†	†	†		†				†				†	†	
45. Gnathia maxillaris			†				†								†		†		
46. Spilæroma serratum																		(†)	
47. ,, rugicauda																			
48. Neomysis vulgaris							†											(†)	†
49. Macromysis flexuosa																			
50. Macropsis slabberi																			
51. Palæmonetes varians		†		†	†	†	†		†				†				†	†	
52. Noctiluca																			
53. Nereis diversicolor		†		†		†	†		†				†				†	†	†
54. Balanus improvisus							†			†						†	†	(†)	†


25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54

BRITISH MUSEUM
NATURAL HISTORY

specimens carried down with the stream into water too salt for them.

The presence of several marine Malacostraca in water in which a fresh-water fauna was able to maintain itself is rather remarkable. The species referred to are *Coremapus versiculatus*, *Corophium grossipes*, *Heterotanais gurneyi* and *Cyathura carinata*, all sedentary or burrowing species. They are found in mud and under bark on some piles supporting the bank nearly opposite the Muckfleet Dike. In this position, where are also to be found *Balanus improvisus* and *Nereis diversicolor*, they are exposed to great changes of salinity, and, during some seasons, cannot be reached by really salt water for very long periods. Of course one cannot say, from the presence of any species in a living state, how long it has been in that place or how long it can remain, but there is no such doubt in the case of *Balanus*, and there is good reason to believe that the other species were really established in their position.

The truly brackish-water species, or those which range on the one hand into fresh water and on the other into salt are the following :—

Balanus improvisus, Darwin.
Tachidius littoralis, Poppe.
,, discipes, Giesb.
Laophonte mohammed, Blanch and Rich.
Nannopus palustris, Brady.
Cyclops lubbockii, Brady.
,, æquoreus, Fischer.
Eurytemora affinis, Poppe.
Gammarus duebeni, Lillj.
Melita pellucida, Sars.
Coremapus versiculatus (Bate).
Corophium grossipes (Linn).
Heterotanais gurneyi, Norman.
Cyathura carinata, Kroyer.
Gnathia maxillaris (Mont.).
Neomysis vulgaris (Thomps.).
Palæmonetes varians (Leach).

On the other hand, a group of species may be distinguished which habitually live in a salinity less than that of the sea-water, but in which fresh-water species are very rarely found. These species are :—

Ectinosoma curticorne, Bœck.
Dactylopusia tisboides (Claus).
Stenhelia hispida, Brady.
Canthocamptus palustris, Brady.
Mesochra lilljeborgii, Bœck.
Delavalia palustris, Brady.
Sphæroma rugicauda, Leach.
,, serratum, Leach.
Idotea viridis (Slabber).
Jæra marina (Fabricius).

The species which I have only found as immigrants with exceptional salt tides are the following :—

Centropages typicus, Kroyer.
,, hamatus (Lillj.).
Temora longicornis (Muller).
Acartia discaudata, Giesb.
,, longiremis (Lillj.).
Euterpina acutifrons (Dana).
Cyclopina littoralis (Brady).
,, gracilis, Claus.

Though the first of these groups include several species which are generally considered to belong to the second or even to the third, so that one may say that, in these rivers, marine types range into water of exceptionally low salinity and into conditions exceptionally unstable, yet it is surprising that the range of some species is not even greater than it proves to be. The existence in large European lakes of species of a marine type, such as *Mysis relicta*, of the many marine forms in fresh water in certain tropical countries, and of such genera as Cirolanides and Cæcosphæroma in springs and deep wells shows that marine species are eminently capable of adaptation to fresh-water conditions. It would be thought that here, with the gradual transition from salt

to fresh, marine forms would find ideal conditions in which to accomplish a migration into fresh water.

Also we know that the rivers and Broads of East Norfolk are relics of what were once arms of the sea, and that, within historically recent times, these bays and estuaries supported a marine fauna. Close to Ludham Bridge some mud cleared out of the river bed this year was thick with shells of *Scrobicularia piperata* and *Cardium edule*, mixed with present-day Unios, and looking as fresh as if they had contained living animals. Why is it that the marine fauna has been driven out ? Why have not some species stood their ground, gradually accustoming themselves to the gradually changing conditions ? Actually the fauna of the Broads, as at present constituted, presents no features indicating a past marine occupation. It has been shown in this paper that salinity is of importance as a factor of distribution, but a good deal of evidence has also been adduced to minimise its importance, and indeed there are yet other factors which must exercise much influence on any marine species immigrating into fresh water, or attempting to maintain themselves in a freshening and shallowing arm of the sea. One of these factors is Temperature.

All our rivers and Broads are very shallow, and consequently the temperature of the water must be exceedingly variable, since the heat of the sun can readily penetrate through the 6 feet or so of our deepest Broads. The temperature may vary from day to day or even from hour to hour, whereas the depth and volume of the sea causes a temperature varying nothing from day to day and little from month to month. The difference of temperature conditions must be a very serious barrier to the immigration of open-sea species, such as *Mysis oculata*, the parent form of *Mysis relicta*, and the fact that this and other " Relict " species only occur in large deep lakes is some evidence of the importance of uniform temperature to them. It has been said* that the differences between the fresh-water and marine fauna decreases from the Poles to the Equator, so that in certain tropical regions one finds a large number of species of marine type inhabiting

* P. & F. Sarasin Materialen zur Naturgeschichte der Insel Celebes, 1898.

fresh-water.* It seems possible that the increasing intrusion of marine types may perhaps be connected with a progressive uniformity of climate and water temperature.

It may be objected that there are littoral and estuarine species which have accustomed themselves to unstable conditions of salinity and temperature—why should they not go further and establish themselves in fresh water? So far as concerns salinity it seems that, though undoubtedly a limiting factor, it is not an absolute barrier. On the other hand, I do not know of observations on the thermal conditions in tidal rivers, but I should imagine that, where a large volume of water is oscillating to and fro in a comparatively deep channel, the conditions will be more or less uniform. It seems that the range of the marine species with which I have been dealing generally stops short at, or before, the point where the stream becomes more or less sluggish. None, except *Neomysis vulgaris* and *Tachidius littoralis*, range into the Broads themselves. If it were only a question of salinity it is probable that our Broads might be tenanted by species such as *Corophium grossipes*, but that low salinity and variable temperature combined prove, at present, an insuperable barrier.

Another factor, which must be of some importance in this connection is the density of the water. Animals accustomed to water of a high density would lose buoyancy when transferred to water of low density and *vice versâ*, so that floating marine species could not maintain themselves at the surface in fresh water, and all fresh-water species would have a tendency to float on water of high density. It is a fact that the marine immigrants are (with the exception of *Eurytemora affinis*) either large vigorous species, or creeping bottom forms, and that the fresh-water species are rarely found alive in the river in water of high salinity.

It seems probable, therefore, that the main causes which have contributed in the first place to drive out the old marine fauna, and in the second place to check immigration, are firstly differences and fluctuations of salinity, and secondly fluctuations of temperature. The latter influence would come

* Weber. Zool. Ergeb. einer Reise in Niederlandisch Ost Indien, 1892.

more and more into operation with the rapid decrease of the tides, caused by the silting up of the estuary mouth, and the resulting shallowing of the Broads and rivers and lessening of the volume of water.

Notes on Certain Species.

The following notes may be regarded as supplemental to my list of 1903, so far as concerns the brackish-water species in the widest sense. I propose to give the names of all species, not already mentioned in my list, which have been found in the rivers from their mouths upwards and also to make a few remarks on certain species which are of special interest.

MALACOSTRACA.

Carcinus mænas (Linn.). The Shore Crab.

Crangon vulgaris (Linn.). Common Shrimp.

Both these species appear to be strictly confined to the river mouths where the water differs little from sea-water. The latter is supposed to occur occasionally at Ludham Bridge, but, so far, I have no proof of it.

Palæmon squilla. Leach. White Prawn.

This is a littoral species, sometimes found in estuaries. Mr. Patterson ('Nature in East Norfolk.' p. 334) states that it is often taken on Breydon. The only place in which I have met with it is Heigham Sounds, where a single large specimen was caught in one of my traps, perhaps the most remarkable capture I have made in the last four years!

Palæmonetes varians (Leach). Ditch Prawn.

When I wrote my list of East Norfolk Crustacea I had only found this species very rarely. Improved methods of capture show that it occurs commonly all the way up the Bure as far as South Walsham, and up the Thurne River as far as Potter Heigham. In the Waveney it is to be found as far as Oulton Broad. Mr. Balfour Browne has taken it in ditches in the neighbourhood of Horsey. Very likely it may prove to occur in Horsey Mere and possibly in Hickling Broad.

Macropsis slabberi, Van Beneden.

This is strictly an estuarine or "Brackish-water" Mysid, not usually found in the open sea, but here it does not extend far up the rivers except with very high floods. During such salt tides it reaches as far as Acle. I have only found it in the Yare at Seven-Mile House.

Macromysis flexuosa, Muller.

Only a single occurrence, at a point between Runham and Stokesby in 1905, during a high salt tide.

HETEROTANAIS GURNEYI, Norman.

Heterotanais gurneyi, Norman.

Norman, Ann. Mag. Nat. Hist. (7) vol. xvii. 1906.

The specimens which were recorded in my earlier paper as "Heterotanais, sp?" were submitted to Canon Norman for examination and were found by him to represent a species new to science. The species is closely allied to *H. orstedi* (Kroyer), but differs from it in the shape of the cheliped. As Canon Norman does not give a figure of the male, one is given here. During the past year the species was found to be not uncommon. At Acle Bridge, in fresh water, it was twice found in abundance, hundreds being washed out of a piece of Cordylophora. It has occurred in the Bure by Ant Mouth, in perfectly fresh water, and may be considered as a brackish-water species in the real sense, being capable of living in both fresh and salt water.

Cyathura carinata (Kroyer). See Plate.

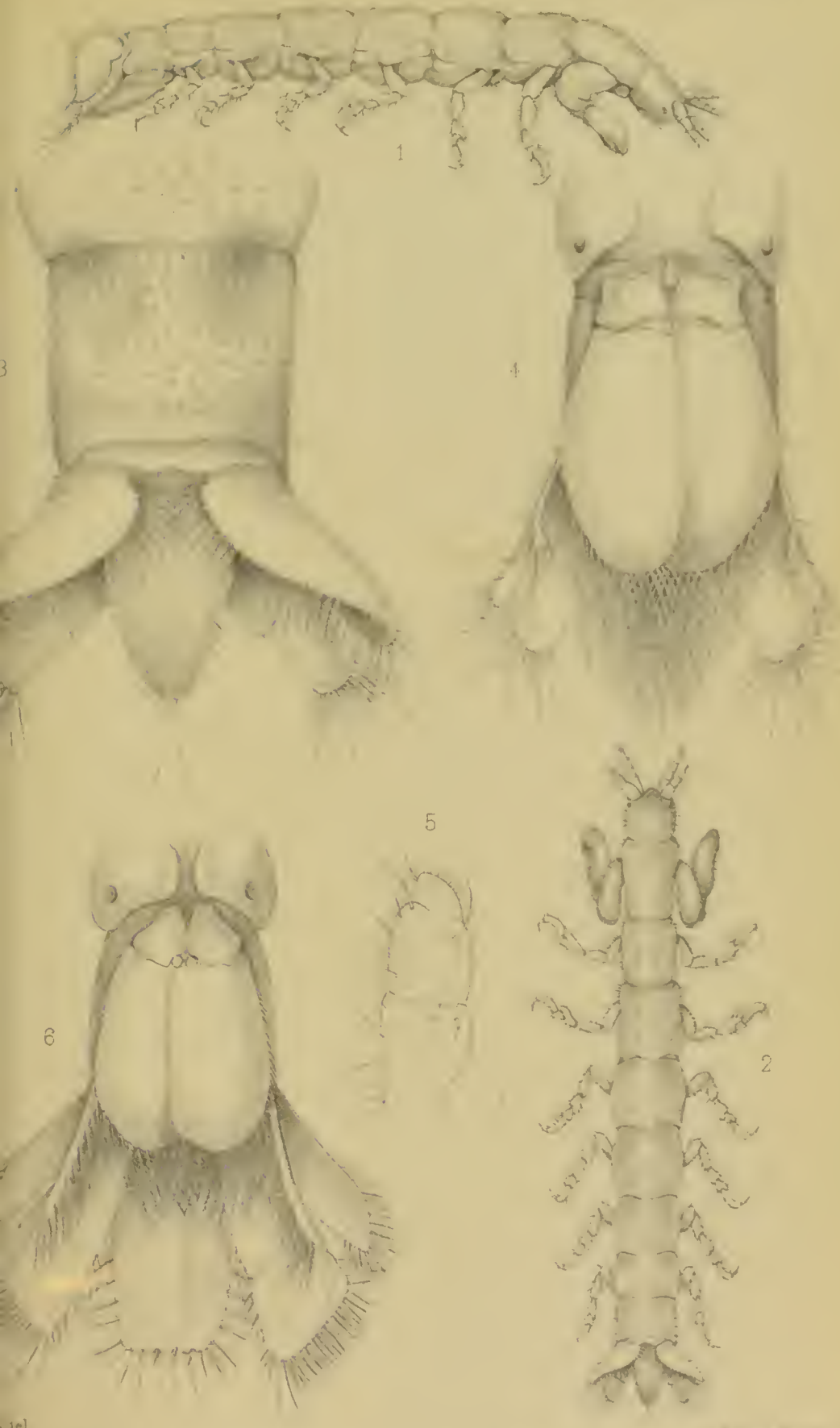
This species has not, so far as I know, been recorded hitherto from the British Islands. Its distribution seems to be as follows:—Eastern North America (New Jersey, Connecticut and Massachusetts), Greenland, Denmark and the Baltic. It has been described and figured by Norman and Stebbing,* and by Kuhlgatz,† but I think it worth

* Trans. Zool. Soc. xii. 1886, p. 124.

† Wissensch. Meeresuntersuchungen, 1898, p. 60.

DESCRIPTION OF PLATE.

Fig. 1 Cyathura carinata, side view × 8.
,, 2. ,, ,, dorsal view × 8.
,, 3. ,, ,, Telson and Uropods, dorsal view × 42.
,, 4. ,, ,, ,, ,, ventral view × 27.
,, 5. ,, ,, Maxillipede × 98.
,, 6. Anthura gracilis, Telson and Uropods, ventral view × 27.



Pyatnura Jarmata Kr.yer

BRITISH MUSEUM
NATURAL HISTORY

while giving some illustrations of it here, owing to its interest as a species new to Britain. It is readily distinguished from *Anthura gracilis* (Mont.), by the rounded form of the telson, the very much larger opercular appendages and by the form of the antennæ. My specimens do not show distinctly the ventral keel from which the species takes its name.

I believe that this is the species referred to under the name of *Anthura gracilis* by Milne Edwards,* and not *Paranthura nigropunctata* (Lucas), as suggested by Norman and Stebbing. Thienemann also.† in describing statocysts in the tail of *Anthura gracilis* was evidently dealing with *Cyathura carinata*. His specimens and those of Kuhlgatz were taken in the Baltic in brackish water in the mouths of rivers.

I have found specimens of this species in three localities, namely on piles by the Muckfleet and at Acle Bridge (Bure), and at Oulton Broad, but it seems to be rare, and altogether I have only taken 5 female specimens. On the other hand, it may not be so rare as it seems, since it requires very careful search to find it. Its habit is to burrow in the fine mud which collects behind the bark of posts driven into the river bottom, or under stones, and it seems to be capable of living in water either fresh or brackish. At Oulton Broad, at the time of capture, the water was very salt, but on the three other occasions on which it has been met with the water in which it was living was practically fresh.

Sphæroma rugicauda. Leach.

In my list I gave only *S. serratum*. Leach, but it seems probable that I may have sometimes confused the two species, since the young of *S. serratum* are not at all easy to separate from *S. rugicauda*. Actually, the latter seems to be the commoner. Both may be met with together, but neither occur in water that is not of a very high salinity.‡ Both are commonly found under stones, and on Enteromorpha.

* Hist. Nat. des Crustaces. iii. p. 136.

† Zool. Anz. xxvi. 1902, p. 406.

‡ The record given of the occurrence of *S. serratum* (1903, p. 650) in Rockland Broad is a remarkable exception.

Idotea viridis, Slabber.

This species appears to be not uncommon in brackish water, but does not occur in company with fresh-water species. In a collection taken by Mr. R. A. Todd in Ploughman's Ham by Lake Lothing, in 1903, there were a few specimens of *Daphnia magna*, but all the other species were of a marine type. The furthest point up-river at which it has been found is Seven-Mile House on the Bure.

Jæra marina (Fabr.).

Under stones in the Yare at Berney Arms, and on weed in a marsh pool at Burgh Castle.

Ligia oceanica (Linn.).

Is a terrestrial rather than an aquatic species, and occurs commonly along the banks of the Yare, under stones, as far as Reedham. Also found at Oulton Broad, but not met with elsewhere.

Talitrus locusta (Pallas).

Orchestia littorea (Mont.).

These are both semi-terrestrial species. The former I have only found at Oulton Broad ; the latter is probably abundant under stones and flotsam along the rivers, as far as the water is decidedly salt. I have found it at Berney Arms, St. Olaves and Oulton Broad.

Melita pellucida, Sars.

This and the following species were most kindly named for me by Mr. A. O. Walker, who informs me that, so far as he is aware, *M. pellucida* has not previously been found in the British Area. It is a species which burrows in the soft mud under stones and the bark of submerged wood, and has occurred in the Bure, by the Muckfleet in fresh water, and at Oulton Broad in nearly salt water.

Coremapus versiculatus (Bate).

=*Microdeudopus versiculatus*, Bate. See Norman, Ann. Mag. Nat. Hist. (7), vol. xvi., 1905, p. 78.

This species is also a very adaptable one. It was first found in company with the preceding one at Muckfleet, but it has occurred since at several points on the Waveney and in Oulton Broad, and seems not uncommon in rather salt water.

LEPTOCHEIRUS sp.

Several specimens of a small Amphipod were taken on piles by the Muckfleet, and also near Stokesby during a high salt tide last year (1905). They were sent to Canon Norman who tells me that they belong to the genus *Leptocheirus* but do not agree with any of the known European species. They resemble in the characters of the gnathopods, the American L. *pinguis*, Stimps—but "as a dwarf to a giant."

COROPHIUM GROSSIPES (Linn.).

In the Victoria County History—Norfolk, Mr. Stebbing records *C. crassicorne*, Bruzel, from the Thurne River. I have searched for this species up and down the rivers for four years but have failed to find any trace of it. *C. grossipes* is a species of a very wide range, being found abundantly at Berney Arms, and I expect on Breydon, but extends also far up the rivers. It is fairly common as far up as Acle and I have found it at Ant Mouth, Ludham Bridge and Heigham Sounds. It seems to be especially fond of living in colonies of Cordylophora and very probably its range is coextensive with the latter. It seems to thrive well in fresh water, in which respect it approaches *Paracorophium excavatum*, Thomson, which lives in the lakes of New Zealand.

COPEPODA.

CENTROPAGES TYPICUS, Kroyer.
,, HAMATUS (Lillj.)
TEMORA LONGICORNIS (Muller).
ACARTIA DISCAUDATA, Giesb.
,, LONGIREMIS, Lillj.

These five species of Calanoida are all strictly marine, and have only been met with occasionally in the rivers in practically salt water. The highest point at which any of them have been taken is in the Bure at Thurne Mouth.

EUTERPINA ACUTIFRONS (Dana).

(For Euterpina in place of Euterpe, Claus, see Norman, Ann. Mag. Nat. Hist. (7), vol. xi., 1903.)

I am indebted to Dr. T. Scott for the identification of this species which he believes has not hitherto been taken on the East Coast though sometimes occurring in the South of England. I have found it at the Yacht Quay and Acle Bridge in the Bure and at Seven-Mile House in the Waveney. In the last two places it was in water rather brackish than salt.

Stenhelia hispida, Brady.

In the Waveney at Somerleyton Bridge, September 24th, 1906.

Delavalia palustris, Brady.

In brackish pools on the marshes at Burgh Castle, and in Ploughman's Ham by Lake Lothing.

Canthocamptus palustris, Brady.

I have already recorded this species from Oulton Broad, where it seems not uncommon. It has since been found at Acle Bridge, at Somerleyton Bridge (Waveney) and at Thurne Mouth (Bure). It is one of those brackish species which seem to prefer water almost salt, but it may be found in almost fresh water.

Mesochra lilljeborgii, Bœck.

Oulton Broad and Ploughman's Ham, September, 1906, in water of very high salinity, and not accompanied by fresh-water species.

Laophonte mohammed, Blanch. and Rich.

In 1903 a single specimen of this rare species was found in the Muckfleet. Since then I have found it there twice, on one occasion in abundance. It has also occurred in the river at Acle in fresh water and in Heigham Sounds, so that it is a species capable of associating with fresh-water species.

Nannopus palustris, Brady.

On piles at Acle Bridge (June, 1906), in fresh water.

Tisbe furcata (Baird).

(For Tisbe in place of Idya, see Norman and Scott 'Crustacea of Devon and Cornwall,' 1906.)

Found only in Ploughman's Ham, September, 1906.

Cyclopina littoralis (Brady).

,, gracilis, Claus.

These are two marine Cyclopids which occur under the same conditions as the Calanoids above-mentioned.

Thersites gasterostei, Pagenst.

Except for *Argulus foliaceus* the fish of these rivers and Broads seem to me to be remarkably free from Crustacean parasites. The only other parasite that I have been able to find is *Thersites gasterostei* which is a peculiar little globular species living on the inner surface of the gill operculum of the Stickleback (*Gasterosteus aculeatus*). Probably it is fairly common, since I have found it on nearly all of the few Sticklebacks caught. These few were taken in the Muckfleet and in the Yare at Langley Dike. So far as I can find, this parasite has only once before been found in Great Britain, namely in Scotland.

CIRRIPEDIA.

Balanus improvisus, Darwin.

In my list of 1903 I recorded a Balanus which I had not succeeded in naming. The specimens were subsequently submitted to Dr. Calman who was good enough to identify them. Darwin, 'Monograph of the Balanidæ,' p. 252, 1854, states that it is a species of very wide distribution, taken occasionally in brackish water. In these rivers it is to be found in the adult condition on piles by the Muckfleet, the Yacht Quay at Yarmouth, Berney Arms and Oulton Broad. On the other hand, Nauplii probably belonging to this species are commonly found wherever the water is appreciably salt. It is curious that, in 1903, though the Nauplii were frequently found in Oulton Broad, not a single adult could be seen; whereas, this year, they were there in abundance.

COELENTERATA.

Cordylophora lacustris, Allman.

I have made some attempt this year to find out the exact range of this species of Hydroid in our rivers. In the Yare and Waveney I have not yet seen it at all. In the Bure it

occurs at Acle, growing on stones on the river bed, but not on the reeds by the bank. Quantities of it drifted down the river on up-rooted reeds between July 4th and 10th. Below this point I have not found it except once in the Muckfleet. Above, it has been found growing at various points as far as Ant Mouth ; growing thickly under the arch of Ludham Bridge, and even in Barton Broad. It was decidedly rare in Barton, occurring only on one or two posts at the south end. In the Thurne River it has long been known to occur abundantly, reaching into Hickling Broad. I have not found it myself in the river, though I cannot profess to have hunted there very diligently, but in Heigham Sounds and Hickling Broad it was abundant on the reeds. It was not seen in Horsey Mere. It is worth noting that it did not appear to grow upon reeds in a reed bed or where there was much shelter ; it was only on the reeds which grew scattered in the open water or in the Deep Dike that colonies were found.

This interesting species is a recent immigrant into rivers. It was first discovered by Agardh in 1816 in salt water at Stockholm ; its name was given to it by Allman (in 1843) who found it in fresh water (?) at Dublin. After that a number of observers recorded it from various places, generally in brackish water. It seems to have rapidly adapted itself to fresh water and has migrated up the River Seine and the Elbe. It found its way from the Elbe into the great water-pipes of Hamburg and there established itself, to the great obstruction of the pipes. Something of the same sort seems to be happening here, for it is not found in the salter reaches of the rivers, but in those parts in which the water is nearly always practically fresh. In Barton it is, of course, in as fresh water as can be found in these parts. Probably it will, before long, be found up the Bure as far as Wroxham.

XII.

METEOROLOGICAL NOTES, 1906.

(From observations taken at Norwich.)

By Arthur W. Preston, F.R. Met. Soc.

Read 26th February, 1907.

January.

This was a mild and wet month, the mean temperature having been 3.4 degrees, and the rainfall 2.26 ins., above their respective averages, indeed the rainfall at Norwich was greater than had been recorded there in the month of January since 1867. Strong winds and gales sprang up suddenly at times, dying away as abruptly as they had come. The high temperature and the almost entire absence of winterly traits made it sometimes appear more like spring than mid-winter, and on some days the mean temperature was higher than on a normal April day.

February.

The most remarkable feature of this month was an exceptionally severe thunderstorm which occurred on the afternoon of the 8th. Thunder was first heard at Norwich

at about 1.40 p.m., and the storm burst with the full fury of a midsummer storm about 1.50 p.m., with very brilliant lightning, followed by heavy and almost instantaneous peals of thunder. By 2.20 p.m. it had passed away. The storm was accompanied by hail, followed by snow, which continued to fall during the greater part of the afternoon. Although winter thunderstorms are infrequent, they do occur at intervals, but are usually local and of short duration, whereas the storm of February 8th was very general, and extended from Scotland to the south coast of England. Churches and buildings were struck by lightning in many parts of the country, but, notwithstanding the extent of the storm, there does not appear to have been any loss of life. There was another thunderstorm accompanied by hail, about 10 p.m. on the 3rd, but this was purely local and of very short duration. The month was, on the whole, coarse and ungenial, and while not severe, yielded more winterly traits than January.

March.

Extraordinary changes of temperature were experienced during this month. On the 6th the shade temperature reached 61.4 degrees, and on the 7th 67.0 degrees. Although the last named reading has been many times recorded in March, it is the first time it has been registered so early in the month since these records commenced, in fact it seems that we have to go back to 1826 for so warm a day so early in the year. This outburst of heat was followed by an abrupt change to arctic cold, the maximum temperature falling as much as 30 degrees in five days. In another five days the thermometer had jumped up to 64 degrees, but it was snowing forty-eight hours later. The second half of the month was the most winterly portion of the winter, with driving storms of snow and hail on several days. The mean temperature of the month was half a degree above the average (resulting

from the outbursts of warmth above alluded to), and the rainfall was .32 ins. in excess of the normal.

April.

As in March, there were in this month sudden and remarkable fluctuations of temperature. On the 12th the thermometer reached 72.2 degrees, which was the warmest day so early in April since 1892. During the Easter holidays the weather was magnificent, with much sunshine, and unusual warmth. On the 18th this genial state of affairs suddenly gave place to a spell of frost, hail, and snow, with the accompaniment of searching north-east winds. But little rain fell till the 22nd, and with the exception of this date and the 27th, when a welcome quarter of an inch was gauged, there was no day on which so much as a tenth of an inch fell. Thunder was heard on the 22nd and 29th. There was generally a great dryness of the air throughout the month, the mean relative humidity from the 9 a.m. readings having been lower than in any month since July, 1887.

May

This was a variable month, with many cold, cheerless days, with some warm intervals interspersed. On the mean the temperature was slightly above the normal, and there was but little frost. The most remarkable occurrence of the month was a heavy thunderstorm on the 13th, which hung over the eastern parts of the county for an unusually prolonged period. At Norwich the storm lasted about twelve hours, from 2 a.m. to nearly 2 p.m., during which time 1.23 ins. of rain was gauged. The centre of the storm, which was of the nature of a cloudburst or waterspout, seems to have chiefly spent itself over the district between Acle and Brundall. At the last-named place 3.21 ins. of rain was registered during the storm (being heavier than any fall previously recorded there), at Acle 3.11 ins., at Dilham 2.14 ins., at Worstead 2.07 ins., and at Catton 2.01 ins. In the western parts of the county hardly any rain fell.

June.

There were considerable fluctuations of temperature during this month, and the changes were, as in the previous three months, very sudden. On the 2nd, 4th, and 14th the maxima were as low as 53 degrees, and on the 29th 55 degrees (or 12 degrees colder than March 7th !), but from the 17th to the 27th it exceeded 70 degrees almost daily. Mean temperature was 1.6 degrees deficient. After the 1st the month was practically rainless until the 15th. The heaviest rains were on the 28th and 29th, when 1.45 ins. fell here in 40 hours. This fall was very general over the South and East of England, and the amounts recorded at different stations in this district varied but little. These heavy rains were caused by a shallow barometric depression, the centre of which passed over the Thames Valley and London.

July.

This was a remarkably fine and warm month throughout, and was the third warm July in succession. The rainfall was greatly deficient, and was but little over a quarter of the average fall. On many days, however, the sky wore a threatening thundery look, though it but rarely developed into thunder or rain. A drop of 15 degrees in temperature on the 19th was another of the many instances of this occurrence, which was a great feature of 1906, particularly from the early days of March. An even more remarkable change in temperature occurred on the 22nd, when the thermometer, which in the early hours of the previous day stood on the grass at 40.5 degrees, jumped up to 80.6 degrees in the shade, and on the following day to 82.5 degrees.

August.

During the first half of the month the atmosphere was in a highly electrical state, and thunderstorms were of unusual frequency. On the night of the 2nd a remarkable storm

occurred lasting for a considerable time, and it was notable for the brilliancy and rapidity of succession of the lightning flashes. Thunderstorms also occurred on the 4th, 8th, 13th, 15th, and 16th, those on the 8th (of which there were three in Norwich) having been exceedingly severe, and during which .80 ins. of rain was gauged. The total fall of rain for the month was 1.87 ins., or half an inch below the average, but the amounts varied much in different localities. Some places were visited by torrential downpours, leaving adjoining spots parched and dried up. Mean temperature was nearly 3 degrees above the average, and was the highest recorded for August since 1893. This was caused by a remarkable heat wave, which partially set in on the 26th, when the shade temperature reached 87 degrees, a point not previously attained all the summer. The following day was as much as 22 degrees cooler, but on the 29th the heat returned, and the thermometer reached 76.4 degrees, 82.6 degrees on the 30th, and 91.5 degrees on the 31st.

September.

The heat wave which set in at the end of August continued during the early part of September, when extraordinarily high readings of the screened thermometer were noted. On the 1st, 2nd, and 3rd September, the maxima were respectively 88.4 degrees, 92.2 degrees, and 93.0 degrees. The last two readings were, with the reading of 91.5 on August 31st, the highest registered since these records were commenced in 1883, indeed it was one of the hottest periods ever known in England. On September 4th there was a drop in temperature of 26 degrees from the previous day, but the heat wave cannot be said to have left us until after the 12th, as readings of 79.2 degrees, 77.8 degrees, and 72.0 degrees were recorded respectively on the 7th, 8th, and 12th. The month generally was very fine throughout, and constituted a protraction of one of the finest summers on record. Harvest was finished in most localities in East Anglia by the end of the first week of the month.

October.

This was another magnificent month, temperature exceeding 60 degrees on 18 days, and reaching 72.4 degrees on the 11th. It formed a great contrast to the previous October, which was one of the coldest on record. Mean temperature (54.2 degrees) was nearly 5 degrees above the normal, and no frost was recorded by the screened thermometer throughout the month. The amount of sunshine was considerable, and although the total rainfall of the month slightly exceeded the average, .86 of it fell on the 2nd, and 1.05 ins. between the 28th and 30th, and as a good deal occurred in the night there were but few wet days.

November.

The month was mild and stormy, with considerable rains during the first nine days. On the 8th 1.05 ins. fell, and on the 4th and 7th .73 ins. and .56 ins. respectively, resulting with other minor falls in a month's total of 4.40 ins., which was the highest total recorded in Norwich in any November since 1878, the year of the "Norwich flood." Many days were unusually warm for the season, and on the 22nd the shade temperature touched 60 degrees, which was the highest temperature registered here so late in the season since these observations commenced, and it is probably the latest "60" since 1856, when 62 degrees was recorded in East Anglia in December. Frosts were few and slight, the temperature falling below 32 degrees in the screen on one occasion only. The absence of frost kept the foliage on the trees to a later date than usual, and many garden flowers bloomed throughout the month. Although the rainfall was excessive, there were many bright intervals, and, as in October, a good deal of the rain fell in the night.

December.

This was a very unsettled and changeable month. Commencing with mild weather, more winterly conditions set in on the 9th, with much snow (locally), accompanied by thunder and lightning on the 10th. Drier conditions prevailed during

the third week with high barometer, but following a dry and very cold Christmas Day, on the 26th and following days came a snowstorm of great severity, exceeding all since the memorable one of the 18th January, 1881. Snow fell to a great depth in all parts of the kingdom, dislocating railway traffic and rendering roads impassable. The accompanying frosts were severe, the screened thermometer falling to 15.8 degrees on the 27th, 18.0 degrees on the 30th, and 19.0 degrees on the 31st.

The Seasons.

The following tables show the mean temperature and rainfall of the four seasons, together with those of the five previous years, compared with the usual averages. Winter comprises the three months December to February inclusive: Spring, March to May; Summer, June to August; and Autumn, September to November.

TEMPERATURE.

Seasons.	1901.	1902.	1903.	1904.	1905.	1906.	Average	Departure of 1906 from average.
	degrees.	degrees.	degrees.	degrees.	degrees.	degrees.	degrees.	degrees.
Winter ...	39.0	37.9	41.8	38.3	39.2	39.3	38.0	+1.3
Spring ...	46.3	46.3	47.3	47.8	47.5	46.7	46.3	+0.4
Summer ...	61.4	58.7	58.7	60.8	62.1	61.1	60.3	−0.8
Autumn ..	50.7	50.1	51.2	49.8	47.5	52.9	50.2	+2.7
Year ...	48.8	48.4	49.5	49.3	49.0	49.7	48.7	+1.0

RAINFALL.

Seasons	1901.	1902.	1903.	1904.	1905.	1906.	Average	Departure of 1906 from average.
	in.	in.	in.	in.	in.	in.	in.	in.
Winter ...	5.88	6.09	3.64	5.96	4.91	7.73	5.37	+2.36
Spring ...	5.10	6.77	5.83	4.59	5.20	5.32	5.13	+0.19
Summer ..	3.61	7.82	10.54	4.70	6.05	4.96	6.87	−1.91
Autumn ...	5.11	4.14	9.77	4.98	8.11	8.75	8.38	+0.37
Year ...	21.06	22.30	29.44	21.50	22.06	28.54	25.75	+2.79

From the foregoing it will be seen that all the seasons were slightly warmer than usual, the greatest departure being the autumn which was as much as 2.7 degrees above the normal temperature. Notwithstanding the remarkably warm periods in the summer the mean of that season was less than one degree higher than the average, owing partly to the somewhat cold June, and partly to the sudden reverses of temperature above alluded to. The rainfall of the winter was 2.36 ins. in excess ; that of the summer 1.91 ins. deficient. The amount of rain which fell in the spring and autumn did not depart greatly from mean conditions.

The Year.

All the months, except December, equalled or exceeded the average temperature, January and August being as much as 3 degrees, and October as much as 5 degrees above the normal. The year's range of temperature was very great, September 3rd having been more than 77 degrees warmer than December 27th. Rainfall was in excess in each month except April, July, August, and September, which were drier than usual, the three latter months giving a combined rainfall of only half the average. The year was chiefly remarkable for many unusual and almost unprecedented phenomena, which have been more or less dealt with in the foregoing description, but which may be summarised as follows :—

1. The wettest January for 39 years.
2. The most severe winter thunderstorm (February 8th) on record.
3. The warmest day in the first week in March for 80 years (67 degrees on March 7th).
4. The great fall in temperature (30 degrees in five days) which followed, and the suddenness of the changes of temperature during the spring and summer.
5. The summerlike weather of Easter, with clear skies and summer heat.

6. The extraordinary thunderstorm of May 13th. lasting twelve consecutive hours.
7. The unusually fine summer and excess of sunshine.
8. The constant succession of electric disturbances in August.
9. The phenomenal heat of 31st August to 3rd September, during which the record was beaten on three days.
10. The latest "60" (on November 22nd) recorded here for fifty years.
11. The extraordinary thunderstorms in December in parts of Norfolk.
12. The snowstorm of December 26th. which was the heaviest for 26 years.

If to these events are added (though not of local interest) the great eruption of Vesuvius early in April, the appalling earthquake at San Francisco on April 18th. and the almost equally severe visitation at Valparaiso on August 16th. it may well be said that 1906 was a "record year," or at least it will long be remembered not only for its fine summer, but for the many unusual and exceptional occurrences which more or less come within the scope of a meteorological summary.

1906.

Month.	Barometer. Highest.	Date.	Lowest	Date.	Mean.	Thermometer. Highest.	Date.	Lowest.	Date.	Mean.	Hygrometer. Mean Relative Humidity. 9 a.m.	Cloud. Estimated Proportion	Rainfall. Inches.	No. of Days.	Wind. Direction. N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Mean estimatd force
	in.		in.		in.	°		°		°	%												
Jan.	30.65	23	29.05	6	29.896	52.0	27	26.8	23	40.7	87	6.8	3.96	22	3	1	0	3	5	4	13	2	4.2
Feb.	30.28	5, 6	28.83	10	29.715	49.0	19	27.4	13	38.1	88	6.9	2.72	22	1	2	2	0	5	5	6	7	3.9
March	30.39	3	28.93	11	29.944	67.0	7	27.0	13	41.4	84	6.6	1.99	20	9	4	1	0	2	6	5	4	3.8
April	30.63	9	29.31	28	30.063	72.2	12	28.8	26	45.6	68	4.6	.66	11	4	8	5	3	2	2	5	1	3.6
May	30.21	5	29.45	16	29.844	73.6	28	31.8	1	53.1	71	3.5	2.67	15	8	2	1	4	3	6	3	4	3.5
June	30.40	5	29.49	1	30.108	78.4	24	36.0	6	56.8	72	6.4	2.31	13	5	7	4	3	1	3	3	4	3.0
July	30.26	9	29.79	19	30.021	82.5	23	44.2	3	62.6	70	5.9	.78	10	3	4	5	2	3	6	7	1	2.6
Aug.	30.43	28	29.55	25	29.971	91.5	31	43.2	28	63.9	68	6.0	1.87	9	1	1	0	3	5	11	5	5	3.2
Sept.	30.62	27	29.53	15	30.192	93.0	3	34.4	27	58.7	73	4.5	1.14	12	3	6	2	6	2	1	1	9	3.1
Oct.	30.40	25	29.25	30	29.830	72.4	11	32.6	26	54.2	85	6.4	3.21	21	2	0	0	5	9	9	3	3	3.0
Nov.	30.52	24	29.07	18	29.839	60.0	22	29.2	19	45.8	88	8.0	4.40	23	0	5	2	3	3	6	8	3	3.2
Dec.	30.63	20,21	29.05	26	29.898	52.2	4	15.8	27	35.5	89	7.7	2.83	24	2	2	4	1	3	2	7	10	3.4
Means					29.943					49.7	78	6.1											3.4
Extreme & Totals.	30.65	Jan. 23rd.	28.83	Feb. 10th		93.0	Sep. 3rd.	15.8	Dec 27th.				28.54	202	41	42	26	33	43	61	66	53	

XIII.

SOME NOTES ON THE COOT, AND GREAT CRESTED GREBE.

By Miss E. L. Turner, F.L.S.

Read 27th January, 1907.

I was first shown the two nests of the Coot and Great Crested Grebe which form the subject of the following notes late in April, 1906.

Alfred Nudd, keeper of Hickling Broad, while hunting for a suitable Coot's nest for me to photograph, had the extraordinary good luck to light upon both nests, only eighteen inches apart, and therefore easily within the focus of a half-plate camera.

Early in May, Nudd began his preparations for my hiding place, and when I returned to Hickling on May 17th, I found the arrangements complete. A tiny duck punt—in which I have spent many days of watching and waiting—had been pushed into the reed bed, having only a heap of innocent looking litter on board. Every day this was worked a little nearer to the nests, until only about eight feet away, then some of the reeds between the punt and the nests were cut away; just an armful day by day, so that the birds gradually became accustomed to more open surroundings; those reeds nearest the nests were not cut away till the day before I commenced operations. On Friday, May 18th, I first became acquainted with these two families of birds, little dreaming that I should be allowed to pry into the sacredness of their domestic affairs, in fact, though on previous occasions I had been successful with the Grebe, hitherto my efforts to photograph Coot had been quite unavailing, so that I had very little hope of succeeding with both these shy birds, together.

However, when Nudd, with that inimitable skill for which he is justly renowned, quietly punted me alongside my future hiding-place, so noiselessly, that neither Coot nor Grebe left its nest till I lifted my head to look at them, my spirits rose, and I became possessed with that determination to succeed which makes those who follow any kind of "sport" utterly oblivious of discomfort or fatigue in attaining their object.

Carefully screwing my camera to the board that does duty for a seat in most punts, and adjusting it, I laid down in the boat while Nudd screened me with reeds, leaving only a tiny peep hole, and waited. Scarcely half an hour elapsed before the Coot returned, and settled herself comfortably, without so much as a troubled glance in my direction, and not five minutes later, the Grebe jerked herself on to her nest, but not before she had carefully scanned my hiding-place with that quiet scrutiny that makes the guilty and nervous tremble. I let them sit for some time, partly because my excitement was so intense, and also, because the sight was so unique and beautiful, I was loath to disturb the serenity of these calm and stately birds. However, I secured three pictures within the four hours—four hours being, as a rule, the limit of my endurance at a stretch.

The plates had to be developed at once while Nudd waited anxiously, all three plates turned out successfully, and there followed one of those moments worth living which every keen naturalist knows.

The next day, Saturday, May 19th, I made my second attempt, from 3 p.m. onwards, these being the hours when the light was best for my purpose. This time, and during the subsequent days, I used my stereoscopic camera. In order to accustom the birds to two staring eyes instead of the one lens, I left a board with false lenses before the birds all night, carefully arranging it so that nothing but the glass showed, therefore whether I was actually hidden or not, the "eyes" were always fixed upon the nests, and I attribute much of my success to this simple contrivance.

On that Saturday I secured the first picture in this series.

The Coot is quietly sitting on her eggs, while the Grebe is in the act of removing the decayed vegetation with which she ALMOST always covers her eggs when obliged to quit them. This action of the Grebe is not as deliberate as a mere glance at the picture would lead one to suppose. On the contrary, the motion of the bird's bill is so swift, just a right and left sweep, that any exposure of less than $\frac{1}{300}$ of a second fails to record it. In fact all this series was taken at that rate of exposure.

In the second picture, the Grebe has not yet returned, her three eggs are unusually well covered, and this photograph shows the rather extraordinary height of both nests. This unusual height may perhaps have been owing to the very heavy eight hours' thunder-storm of the previous Sunday, when the water rose considerably and the nests of many of the ground-building birds were swamped. Indeed, Nudd's cheerful greeting when I arrived the day before was, "There's nothing left for you to photograph except the Coot and Grebe: they're all washed out."

On Sunday I left the birds in peace. Next day, May 21st, I uttered a loud exclamation of dismay as we glided up to my nests. They presented a most disorderly appearance, especially the Grebe's (plate 3), so that I felt sure rats had destroyed the eggs, but on pushing up close to the Coot's nest, out tumbled two animated balls of fluff, which at once found a hiding-place in the reed beds, only betrayed by little silvery-bell-like cries of distress. Also there were but two eggs in the Grebe's nest, and these two quite warm, so quietly and hastily slipping into my hiding-place, I anxiously awaited results. That was a never-to-be-forgotten day. I soon found that I need only crouch behind the bank of litter that covered my camera and be as quiet as possible in changing the plates. Nobody minded me, so absolutely absorbed were these four parents in their little families. The Coot soon returned with her two chicks, and the latter found climbing into the nest a much more arduous undertaking than the roll out had been. The male Coot came to and fro with food all day, both for his mate and the chicks (plate 6). The Grebe also came back

very quickly, but instead of settling down calmly and quietly as heretofore, she seemed strangely excited, moving her head from side to side with ear tufts and crest erect, yet paying no attention to me, so that I knew she was not alarmed. Suddenly she jumped up, uttered a little quick cry of joy, and at the same moment her mate returned with a tiny Grebe chick (plate 3). A great deal of delighted conversation ensued, the joy of the parents over their firstborn was almost human. It is impossible to describe in words the variety of inflections in this " baby language " which the old Grebe used when talking to, or about, their chicks. Those who have only heard the somewhat harsh, guttural cries of the adult bird can have no idea of the variety of expression and delicate modulation of which their voices are capable. I have also been very much impressed with this fact when watching at close quarters two Red-backed Shrikes feeding their young.

When the young Grebe had been sufficiently admired for his powers in swimming, and allowed a little rest, the male bird slipped on to the eggs, while the female swam away with the chick. This went on all day, both parents taking turns on, or off, the nest, the chick of course enjoyed intervals of rest under his parent's wings, or surveyed his little world from their warm shelter. The little head bobbed up and down if I made a slight movement; or if the parent slipped off the nest in alarm the little one would be dragged away holding on to the down beneath his parent's tail, and so hoist himself on to her back before they were out of my sight. If mother and son were at rest, the male bird came to and fro with food for both. At first the female took the fish from her mate and fed the chick herself as it lay under her wing (plate 8), but after the first day, the male gave the chick food direct.

On Tuesday, May 22nd, there were three Coots and two Grebe chickens. The tiny Coots again scrambled into the water till I hid myself, returning later with their parents. As soon as the Grebe came back she at once began removing the broken eggshells (plate 4). I judged from this the second chick had not long been hatched.

On one occasion whilst the Grebes were absent, the Coot paid the visit of inspection to her neighbour's nest, depicted in plate 5. Whether this visit was inspired by mere feminine curiosity, or spite, I am unable to determine, certainly she gave one of the Grebe's eggs a vicious poke and started off guiltily when I released my shutter, moreover, that third egg of the Grebe did not hatch out!

In plate 6, both Coots are feeding and admiring their young ones, which unfortunately do not show up, owing to their small size and general duskiness. All that Tuesday the Grebes behaved as before, except that there were two chicks to admire and feed. It struck me that the young Grebe must have no small difficulty in "hanging on" when the parent bird jerks on to the nest in the somewhat ungainly manner peculiar to it. One favourite trick of the male Grebe puzzled me much; he would lure one chick to the edge of the nest, then, dipping a feather in the water would shake it before the little one, swimming to and fro uttering encouraging sounds as he did so. The feather was constantly dipped in the water and shaken. Perhaps in this way the chick is taught to cling to its parent's feathers; but as feathers are found in the gizzard of the Great Crested Grebe "instead of stones" (see Pycraft's 'Bird Life'), it may be the young birds are thus early taught to swallow them for digestive purposes. I cannot say I actually saw the young Grebe swallow feathers, the manœuvre, though often repeated, had no definite result as far as I could see.

In plate 7, the Coot is covering her chicks and watching for her mate. The male Grebe is swimming away with both young birds under his wings, and the female inspecting her one remaining addled egg.

On Wednesday, 23rd, the Coot had successfully hatched out her four young ones, and though always in the nest when I went to my hiding-place, did not return to it all the while I was there, but swam about its neighbourhood for hours at a time, evidently returning to the old home for several nights. The Grebes soon forsook the one remaining egg, and devoted themselves to their two chicks, so that my oppor-

tunities for observation of these interesting birds came to an end. Six weeks later when I again returned to Hickling, I frequently met the two young Grebes then in the hobble-de-hoy stage, enjoying life and youth to the full, disporting themselves up and down Heigham Sounds of an evening with, or without their parents.

I could not see what benefit these two families of birds derived from their proximity. As far as my observation is concerned, Coots and Grebes generally build near together, and perhaps, as both are exceedingly wary birds, some amount of mutual protection is gained. But as far as these birds were concerned there seemed to be no intercourse between them. In fact, the male Grebe kept strict guard over the space between the nests and never allowed the male Coot to come up that alley, but forced him to feed his mate on the left hand side of the nest, as in plate 6. Any infringement of this rule was promptly punished. The female Coot seemed to regard the covering and uncovering of the Grebe's eggs as a piece of unnecessary caution, judging from her expression.

I will add, in conclusion, that all the time I was trying to photograph these birds a very strong north wind was blowing, which made it impossible for me to venture on a lengthy exposure, even had the rapid movements of the birds allowed of this, so that I am sure the reproducer of these plates is to be congratulated on getting the best possible results from considerably under-exposed negatives.

EXPLANATION OF THE PLATES.

No. 1. Coot on nest and Grebe uncovering her eggs.
No. 2. Showing the unusual height of the nests.
No. 3. Coot on nest with two young ones, and female Grebe inspecting her newly hatched young one.
No. 4. Female Grebe removing egg-shell from nest.
No. 5. Coot visiting Grebe's nest during the latter's absence.
No. 6. Both Coots bringing food to their young ones.
No. 7. Coot covering her young and male Grebe swimming away with chicks under his wing.
No. 8. Female Grebe feeding chick under her wing.

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For explanation of the Plate see page 454.

BRITISH MUSEUM
NATURAL HISTORY

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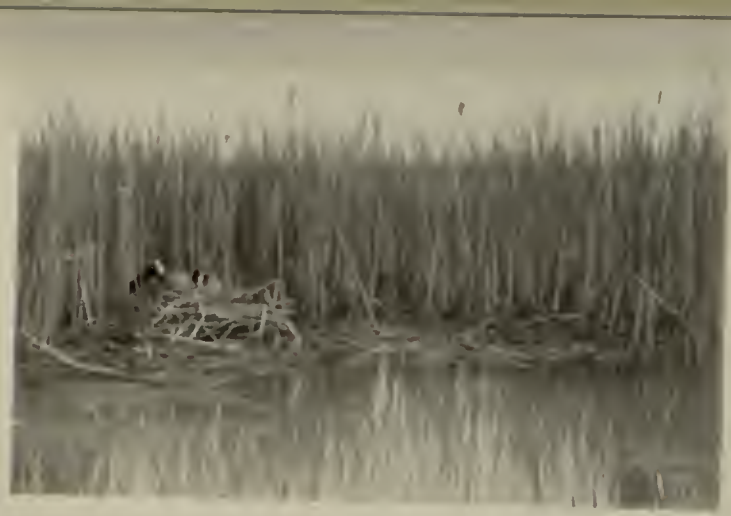

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For explanation of the Plate, see pa. 451

BRITISH MUSEUM
NATURAL HISTORY

XIV.

NOTES ON THE YARMOUTH HERRING FISHERY, 1906.

By T. J. Wigg.

Read 26th March, 1907.

The Yarmouth Herring Fishery may be said to occupy at least ten months out of the twelve, although the catches of Herrings during January and February are, as a rule, too small to be noticed. During April of 1906 the Herrings landed at Yarmouth and Lowestoft together totalled 911 lasts or 9110 crans.

Of course the main fishing season is during the months of October, November and December, when the best Herrings are landed and the chief business is transacted. The month of October was the best month of the season both for weather and quantity of Herrings landed, and also for the good prices secured for the catches. The cran system was definitely adopted by boat owners and, with the exception of a few sailing luggers, "telling" has to all intents and purposes ceased. The resolutions passed by the trade are as follows :—

"That on and after Monday, October 15th 1906, all fresh Herrings delivered from steam-boats, shall be sold by cran measure, and that all fresh Herrings ex sailing boats may be, and all salt Herrings must be, sold by count, and further, that in every case, all Herrings must be placed in the swills, 'over' to be placed in extra swill or swills on each five-cran or half-last lot.

"That salted Herrings, ex steam boats, may be cranned or counted at the option of the owner, provided always that the Herrings are placed in the swills as determined by the foregoing resolution."

The publications of these resolutions has caused great dissatisfaction among the large number of men who, during

the fishing, are accustomed to get their living by "telling" Herrings.

The quicker despatch enables the boats to get away sooner, and in many ways the change has proved most beneficial for the quicker clearance of fish cargoes.

To give some idea of the addition to the population of Yarmouth during the height of the Herring season it may be stated that there were over 4,200 Scotch fishermen and about 4,000 Scotch Herring lassies, and in addition there were Scotch curers and salesmen, agents, shipbrokers, coopers, carters, &c., drawn from all the ports between Berwick and Wick. The visit of the Scotch fleet thus brings in its wake an increase for some weeks of not far short of 10,000 to the normal population.

Notwithstanding the enormous catches of Herring which were landed during the early part of the fishing the prices were maintained in a most remarkable manner. Probably this is to a great extent due to the splendid market for pickled Herrings on the Continent.

Taken all round, the season of 1906 has been a bad one for sailing craft. This was doubtless due to the bad weather which prevailed during the busiest weeks of the season. One cannot help imagining what a season it would have been had the weather not played such havoc with the fishing for several weeks.

"The high prices which were kept up from start to finish have been all in favour of the fishermen. In round numbers the catch landed at Yarmouth and Lowestoft was between 600,000 and 700,000 crans; but taking it at 600,000 crans, at an average price, 30s. a cran, we have the handsome earnings of £900,000 to divide among the fishermen. It may be argued that a number of the fishermen in sailing craft were unfortunate in never having a good shot, but this happens every season, however good the general fishing may be, and £900,000 goes a long way round in a division, so that if some have done ill, there can be no doubt that others must have done exceptionally well."—*Fish Trades Gazette.*

During the early part of the Herring season the busy Fish

Wharf was visited by the member for the Borough, A. Fell, Esq., who was accompanied by Lord Milner. His Lordship, piloted by Mr. Fell, went the whole length of the Wharf, and evidently took much interest in the busy scene. He commented on the fact that so many steamers were at the Quay and no sailing boats. This was readily explained by the fact that the sailing boats discharged earlier and had gone to seek their Sunday berths. Lord Milner then visited the gutting grounds, where the lassies were busy at work, and was astonished at their remarkable agility with the knife. He next visited the Herring houses where the lassies work under better conditions, and where red Herrings, bloaters and the luscious kipper are prepared for export. He also inspected the pickling operations, and appeared to be very interested in all he saw.

With their usual courtesy, Mr. W. L. Smith, the Yarmouth Borough Accountant, and Mr. W. J. Henderson, the Lowestoft Harbour Master, have again furnished me with the following particulars of Herrings landed and boats engaged.

RETURNS OF HERRINGS LANDED AT YARMOUTH IN 1906.

Month.	Lasts.	Month.	Lasts.
January	—	Brought forward	311
February	—	July	211
March	16	August	919
April	92	September	1,381
May	34	October	16,862
June	169	November	13,346
		December	2,027
Carried forward	311	Total	35,057

Number of Yarmouth boats employed, about . . 198
,, Scotch and other boats employed, about 636

RETURN OF HERRINGS LANDED AT LOWESTOFT IN 1906.

Month.	Lasts.	Month.	Lasts.
January	—	Brought forward	1,155
February	—	July	188
March	63	August	9
April	819	September	68
May	131	October	12,397
June	142	November	10,126
		December	1,703
Carried forward	1,155	Total	25,646

Number of Lowestoft boats employed, about . . 233
,, Scotch and other boats employed, about 596

XV.

SOME ADDITIONS TO THE NORWICH CASTLE-MUSEUM IN 1906.

By Frank Leney.

Read 26th March, 1907.

Although many other donations to the Museum in 1906 are doubtless of interest to the members of this Society, the following may perhaps be deemed more than ordinarily so, viz., a well-mounted example of Mrs. Gray's Waterbuck (*Cobus maria*) from the White Nile; shot by the donor (Mr. Edward North Buxton of Buckhurst Hill, Essex), for the Norwich Museum by special permission of the Egyptian Government. This rare Waterbuck is one of the most handsome and striking of all the African water-loving Antelopes. Mr. Buxton also presented mounted heads of Grant's Gazelle (*Gazella granti*) from the Rhombo River, British East Africa; White-eared Cob (*Cobus leucotis*) from the White Nile; Impala Antelope (*Æpyceros melampus*) from the Rhombo River; Sœmmerring's Gazelle (*Gazella sœmmerringi*) from Somaliland; also horns of Arabian Ibex (*Capra nubiana*); and Siberian Argali (*Ovis ammon*) from Mongolia. With the exception of the last named they were all killed by the donor, and those members who were present at the lecture, given by him to this Society, will recall many of the Antelopes which he so graphically described with the aid of some remarkable photographs of the animals in their natural habitat.

Mr. A. Heneage Cocks, of Skirmet, near Henley-on-Thames, has again favoured the Museum by adding to the Mammalian collection a fine adult ♀ Wild Cat captured in Inverness-shire and a kitten bred in his menagerie. Mr. Frederick Ringer of Nagasaki presented a skull of a large "Killer-Whale" (*Orca*, sp.) caught off the coast of Korea by the crew of the Whaling steamer "Volga" in 1905.

I am indebted to Mr. J. H. Gurney for the following interesting notes on two species of Birds of Prey acquired by him for the Museum, *Spiziapteryx circumcinctus*, and *Accipiter salvini*.

"In November last, Mr. W. F. Rosenberg received a consignment of Bird skins from the Argentine, South America, which included a pair of *Spiziapteryx circumcinctus*, Kaup, a species described as long ago as 1851, and the only one of its genus. These birds, I am happy to say, have been secured for the Castle-Museum, they are about the size of an English Merlin with white rumps and broad white bars on the tail, but the two middle tail feathers are black in both of them. Of the two the female is considerably the larger. Neither of them shows the double notch in the upper mandible distinctly, and this leads me to think that they are not adult; in Martorellis' plate (Soc. Lig. di Sc. Naturali e Geo. X) this feature of the beak is a good deal plainer, and the black on the tail is also more extended. The tickets state them to be male and female, shot respectively on the 28th January and the 1st of February, 1906, at Isea Yaen, Santiago, which is on the Pacific side of the Continent. My father's observations on this very distinct form, of which he never possessed an example, will be found in 'The Ibis' for 1881, p. 275; it is rather singular that so many years should have elapsed before we acquired a bird which in its own country is no doubt common. My father places it next to *Dissodectes*, an African genus; it also approximates to *Harpa*; but that its characters entitle it to stand alone is evident.

Accipiter salvini, Ridg. the Venezuelan representative of *A. chionogaster*, from which this small Hawk differs in its deep rufous tibiæ, dusky auriculars, and narrower bars of grey on the tail, is separated from the latter in Sharp's 'Handlist of Birds' (1899), and in my father's 'Diurnal Birds of Prey' (1884)—but *cf.* 'Ibis,' 1892, p. 328. It will probably hold its ground as a sub-species, but not more."

Mr. Edward Knight gave a nestling and five eggs of the Black Swan (*Cygnus atratus*) laid in confinement, and Mr. H. H. Halls, a Hoopoe (*Upupa epops*) which was shot at Lakenham, Norwich.

To the collection of Fish, the Rev. Maurice C. H. Bird added a hybrid Bream-Roach, taken at Hickling ; this was interesting to many members on account of the correspondence in the 'Field.' Another noteworthy addition is that of a Fox-shark or Thresher (*Alopecias vulpes*) measuring 10 feet 8 inches in total length, taken in the nets off Hasboro' and brought into Cromer. Mr. Thomas Southwell recorded its capture in the October number of the 'Zoologist.'

A section of Economic Biology has been formed and the Castle-Museum Committee hope to obtain the active co-operation of local entomologists, botanists, and others interested in the subject. Realistic models of foliage, etc., damaged by Chafer-beetles, Strawberry-beetle, Wireworm, and Cabbage-moth, have been placed on exhibition in the Museum. Each exhibit is accompanied by a descriptive label, based whenever possible on the leaflets issued by the Board of Agriculture, which explain the life histories of the pests and suggest a simple method for their destruction and prevention.

The total number of visitors to the Castle-Museum during the year ending December 31st, 1906, was 110,217.

XVI.

NATURAL HISTORY NOTES FROM YARMOUTH.

By Arthur H. Patterson.

Read 26th March, 1907.

1906.

The year 1906 has been, to me, one of exceptional interest, by reason of the success which has attended my endeavours to work out, in a more systematic fashion, the Marine Fauna of the neighbourhood. Early in March it occurred to me that a little diplomacy in the matter of enlisting the good will

and sympathy of the local shrimpers, might add to my lists of Fishes and Crustaceans. I had experienced hitherto great disappointments with regard to strange "finds," which had often been "hull'd overboard because you didn't come," or "they hadn't time to find me up." So I thought of a scheme which I at once put into operation. I collected a considerable number of empty, broad-based paste bottles from the various lawyers' and other offices in the town: these I cleaned and half filled with formalin, and gave them to a shrimper friend, who drives himself about in an invalid's chair, to distribute to the various shrimp-boats, and gather them in again at intervals. These men were glad to help their unfortunate comrade, whom I also paid a small fee weekly. It was interesting, to me, to see him carrying out my instructions, in his conveyance. From this source (with the exception of the New Scomber) the whole of the following list of species, new to Norfolk, were obtained :—

Fishes.	*Scomber thunnina*.
	Jago's Goldsinny (*Ctenolabrus rupestris*, Cuvier).
	Megrim (*Arnoglossus laterna*, Günther).
Stalk-eyed Crustaceans.	"Ross" Crab (*Xantho rivulosa*, Edwards).
	Livid Swimming Crab (*Portunus holsatus*, Fabr.).
	Leach's Prawn (*Palæmon leachii*, Bell).
	Hippolyte pandaliformis Bell.
	Sowerby's Hippolyte (*H. spinus*, Bell).
	Thompson's Hippolyte (*H. Thompsoni*, Bell).
	Spiny Shrimp (*Crangon spinosus*, Leach).

The Brambling appears to have been fairly abundant in the latter part of the winter of 1905-6. Quite a number congregated on the litter left after the removal of a haystack on the Southtown marshes in January. The seeds of a certain weed, possibly the Charlock, were an attraction to them.

An adult Gannet was brought me alive on January 18th; it had been blown by a strong wind into the sail of a fishing-boat.

Wood Pigeons were exceedingly plentiful in the neighbourhood in February, and were destructive to the young crops.

February 26th. Saw a Sowerby's Hippolyte for the first

time, but the shrimper, who is collecting specimens for his own amusement, would not part with it.

March 2nd. Examined a very dark example of the Rock Pipit which had been shot at the harbour mouth.

March 31st. A great many dead examples of *Corophium longicorne* floating on the top of a ditch near Breydon walls.

A flight of Water-rails appears to have passed on March 31st. A tired out example was brought me, having been fished out of the river on that date, and a second was picked up dead under the telegraph wires on the South Denes on April 1st.

April 8th. Watched a Snipe "drumming," had a good view of him from behind a scrubby tree, and am quite convinced that the noise is produced by the forcing of air through the spread tail feathers by means of the wings.

On April 11th a Hermit Crab that had found up an empty snail shell and appropriated it, was brought me from a shrimp-boat. The shell, polished by the action of the sea, was singularly beautiful for *Helix aspersa*.

April 17th. Quite a couple of hundred Wigeon on Breydon; and on same date I obtained a fine example of the common Prawn (*Palæmon serratus*), also from Breydon, a most unusual locality.

As late as April 26th a Hooded Crow remained on the mudflats.

On the same date a very pretty Bubalis (*Cottus bubalis*) came to hand: length $2\frac{3}{4}$ inches, and subsequently some others.

April 30th. Two Montagu's Suckers (*Liparis montagui*), both females, and a Megrim, or "Scald-fish," $4\frac{1}{2}$ inches long, were brought me by a shrimper. And on May 1st, two more Montagu's Suckers, each heavy in spawn.

During the dry weather in May the Wireworms attacked the Earthworms on the St. George's Park, fixing themselves to the middle of their victims, and simply draining them of the moisture in their bodies. Hundreds came to the surface, sometimes with these larvæ attached, and died.

That pretty little Cephalopod, the Little Squid (*Sepiola rondeletti*), was exceedingly abundant this spring: a shrimper's

wife collected all her husband caught, to sell to an Italian neighbour, who was very fond of the species; I myself found it toothsome enough when boiled.

On May 4th, I was much interested in watching Rooks prowling at the edge of the mudflats collecting small crustaceans, until quite a walnut-sized lump of them distended pouch-like, the throat of the bird; these they were collecting for their young on the treetops in the old Cemetery behind the Market Place. Same date, a goodly muster of Whimbrel on Breydon; and 100 in one flock on May 8th.

May 6th. An old Heron wading systematically up and down the Breydon drains; he simply "walked up" his prey, and fared better than do the young ones in August which, until they have learned wit, remain in one spot and *wait* for the fish to come within reach. Two Little Terns (*Sterna minuta*) same date.

The Swifts came back on May 9th (after two warm days) to find the High Mill, their former resort, taken down. Three pairs flew around excitedly all the afternoon and evening at an elevation level with the old nesting sites, and then in the cold gloom of the same night went away again. They returned a few days later, and appear to have found fresh quarters.

On May 11th I was shown one of the small claws of an Edible Crab that, instead of one sharp-pointed *chela*, had two, both moveable, and meeting very much after the points of a pincer claw.

On May 14th *Xantho rivulosa* (Risso's Crab) came to hand for the first time. A hairy stout-built fellow, with enormously developed pincer claws. In a tank I found it exceedingly sluggish, as its appearance suggested. After that date quite a number, ranging in size from a horse-bean to a large walnut, was brought me.

May 15th. A great number of Sail Flukes (*Rhombus megastoma*) on sale in the town: taken in deep waters. Some ran to 18 inches in length.

May 22nd. White Prawns (*Palæmon squilla*) abundant on Breydon. Jary, the watcher, had trawled up some pints of crustaceans, including this species. Sand Shrimps and Ditch

Prawns (*P. varians*) which he boiled in a "promiscous lot." They ate fairly sweet, but when one remembers what is sometimes lying in the muddy channel, half the zest of appreciation was taken away.

Two living Sea Anemones brought me, which I kept for a few days in a tank; one was a fine Ringed Deeplet (*Bolocera eques*) and the other a beautiful example of *Stomphia churchiæ*.

In May I made some experiments that, to me, were very diverting: I placed a Three-spined Stickleback (*Gasterosteus aculeatus*) into fresh water, and after two days' quietude there, I transferred it to a tank of sea-water, with some Whelks, a Sea-anemone, and a Risso's Crab (*Xantho rivulosa*) for companions. Here it seemed perfectly at home for five days, when I again dropped it into fresh water with some small Carp. Nothing appeared to upset the little fellow's equanimity.

On June 5th a Jago's Goldsinny (*Ctenolabrus rupestris*) was brought me in one of my shrimp bottles. This is the first record for the Norfolk coast.

On June 6th a young Dunlin was observed on Breydon, and several next day.

On June 9th *Crangon spinosus*, the Spiny Shrimp, came to hand for the first time. The red spots, and the characteristic white band on the fourth segment, as described by Gosse, added to the short second pair of legs are unmistakable. It was heavy in ova.

Hippolyte cranchii turned up plentifully this season. It is a short stuggy little creature.

The shifting of the Scoter Ducks (which were regular winter frequenters off the shore between Yarmouth and Caister) to the bay-like gap south of Gorleston is significant. North of the Bell Buoy there existed a few years ago a considerable Mussel (*Modiola*) bed, on which these birds fed. An incursion of Cross-fish (Starfish) completely eradicated this "lay," and this season only empty valves were dredged up by the shrimp-boats.

When a shrimp-boat gets its net fast to a piece of sunken wreck the shrimper has often to remain there the remainder

of the tide, hoping, with the turn of it, to draw off again. He is content, if he does not lose his net altogether, to come off with a torn net and an empty "poke." Sometimes the net is hauled in entire, but with the cod-end covered with Whelks, which have in the meantime been cleaning out the catch, leaving but the empty "shells" of the Shrimps therein.

Pennant's Swimming Crab (*Portumnus variegatus*) for the first time, to my knowledge, was captured on Breydon in June, also *Nika edulis* came to hand freely from the shrimp nets in that month.

On June 17th I obtained on Breydon a White Goby (*Latrunculus alba*), and on the same day I saw a Hooded Crow sitting on a Breydon rail.

June 10th. A 3-lb. Turbot, wholly white on the upper surface, save for a ring of the normal colour around each eye, was on a fish stall. The spiny processes were entirely absent, and the surface of the fish felt like porcelain.

In June and July, Breydon and the neighbouring salt waters were literally alive with young Herrings ("Whitebait"): flounders and eels fed on them ravenously, to the annoyance of the eel-babbers. Terns and gulls also devoured them to repletion. And their abundance undoubtedly had something to do with the unusual number of Mackerel that visited our waters, at a period corresponding with the old and obsolete Mackerel fishery.

Boat owners sent out quite a number of luggers in quest of the Mackerel, and some remunerative catches were made. Altogether some 145 lasts, 12,000 fish going to a last, were accounted for; prices varying from 12s. to £1 per hundred. One boat earned £150 for a two months' trip (in May and June).

On June 27th I obtained a 15-inch Mackerel which was entirely devoid of the characteristic stripings.

July 4th. I obtained for the first time an example of *Loligo media* (a sharp-tailed Cuttle) on Breydon. I, curiously enough, "spotted" it entangled in the meshes of a net hung to dry from a mast-head when rowing by in my punt. I clambered aboard and secured it, to the amusement of several

Breydon-side loungers, who quite sympathise with my "eccentricities."

Soles were extremely numerous in the neighbourhood in July. Several shrimpers exchanged their shrimp-dredges for the trawl. I saw 56 pairs in a shrimp shop one day that had been taken in two 16 feet beam trawls. On Breydon some excellent fish were taken.

On July 10th a two-feet 7-lb. *Scomber*, hitherto unrecognised as British, came to hand fresh from the roadstead. The species was determined by Mr. Southwell as *Scomber thunnina*, and satisfactorily confirmed by the British Museum authorities. It was preserved by Mr. Roberts and is now in Yarmouth Tolhouse Museum.

On July 13th for the first time I saw Leach's Prawn (*Palæmon leachii*). On the same date I obtained two alive, one in full berry, which the poor wretch, on being dropped into formalin, immediately shed. I found at another shrimper's a fourth lying on a board amongst a heap of boiled Shrimps; thus making up a goodly number, in one day, of a species hitherto unrecorded for Norfolk.

A considerable influx of Sea Trout (*Salmo trutta*) occurred in the middle of July. Fifty pounds weight were netted in one night. One fine fish scaled 16¼ lbs., and several weighed12 lbs.

On July 21st I saw and watched for some time a Pelican sitting in the middle of Breydon, not far from my houseboat. The evening was still, and not a bird came near it. Its pouch was full (presumably of flounders), and it was somnolent most of the time I saw it. Continuous south-westerly winds, and a continuation of abnormal heat would possibly account for its wandering here. I am always chary of possible "escapes," but feel quite satisfied the bird was a genuine wanderer.

On July 23rd a remarkably deformed Salmon came to hand. The snout immediately from before the eyes turned round in a perfectly circular fashion, and was lost under the roof of the mouth, the lower jaw and tongue-end protruding in the normal manner, some way in front of this "forehead." The fish, which was in good condition, was eaten.

Norwegian Lobsters (*Nephrops norvegicus*) were on sale in good numbers all the summer and met with very ready purchasers.

On July 30th a very fine Megrim came to hand from a shrimper, and a 10-inch Lemon Sole (*Solea lascaris*) on August 8th.

Several Little Terns feeding their young ones on the Breydon flats. First and second weeks in August.

August 20th. A Spoonbill on Marshes.

August 29th. The largest "show" of birds on Breydon I ever saw at one time. Among them I noted: 3,000 Gulls; many Little Terns; Common Sandpipers; Godwits, Knots, Curlew-Sandpipers, Dunlins, Herons, Curlews, Ringed Plovers, Redshanks and Greenshanks.

On same date I observed two Redshanks deliberately alight in deep water and start swimming.

August 29th. Saw a "Red" Cod, about 20 inches in length; the only other one, so distinguished, I saw on Christmas Eve, 1890.

September 3rd. Four Glossy Ibises on Breydon. Wind south; fearfully hot.

On September 4th I saw an amateur punt-gunner, named Young, making ready to go up Breydon in a considerable state of excitement. He informed me he had seen four Glossy Ibises, and "meant, if possible, to have a slap at them!" Instead, he fell in with thirteen ducks which he fired into with telling effect, recovering nine, killed and wounded. The birds appeared tired and tame on arrival, but the cripples gave him an arduous half-hour's retrieving. Two wounded birds reached the marshes and were afterwards discovered and captured, and were in both cases eaten (*vide* 'Zoologist,' Oct., 1906, p. 394-5). Young ate one badly mauled bird, and sold eight to Saunders, the stuffer. I saw all these birds, either in the flesh or in the skin; they were Red Crested Whistling Ducks (*Fuligula ferina*). One I ate was exceedingly well tasted. Of the eight birds only two were females; and none were in adult plumage.

On September 8th two others were shot at Hickling. The

same climatic influences which affected the Glossy Ibises and Pelican, I take it, tempted hither this rare waterfowl.

On September 8th I was much entertained at seeing a young Heron attempting to swallow a flounder much too large for its capacities. Two or three gulls drew up hoping to see it throw the fish away in disgust, but it persevered. Still more gulls came along, and still more until some scores were running to see what was happening. In a short time I roughly counted as many as 200 gulls surrounding the stupid Heron, the outside birds, like folks on the edge of a crowd, not knowing, I am convinced, what they were hurrying up for, but simply judging by the actions of those who had preceded them that something unusual was happening. The Heron eventually dropped the flounder, and took to wing.

September 16th. Hooded Crow on Caister sand-dunes. A rather unusual show of Golden Plovers, September 18th, heading N. on a S.E. wind!

September 19. Saw the first migratory Rooks coming in.

Teal showed up in rather more than usual numbers in September. One gunner killed twelve in one day. For years past a perceptible lessening of this species has been apparent.

I witnessed an interesting "passage" of small migrants early on the morning of October 9th, on the North Denes: Linnets, Greenfinches, Redpoles and Twites passed overhead in continuous flocks, and unmistakably among them quite a score of Common Sparrows. The flocks of finches ran from half a score to thirty birds, Larks were also coming in. Wind S.W. by S. at 6 a.m., and had veered to S.S.E. by 7 o'clock.

October 10th. Great numbers of Larks coming in. In this month the pretty Swimming Crab (*Portunus holsatus*) occurred; and an example I sent to the British Museum was returned to me on October 19th with a note from Mr. G. A. Boulenger confirming my finding.

On October 20th near the harbour mouth, I fell in with an immense number of Herrings that had been drawn in by an undercurrent. Almost every specimen had a Brazil-nut shaped

piece bitten out of the back, the work of the rapacious Piked Dogfish.

October 24th. I obtained an Anchovy, 6¾ inches long. Quite a considerable number of full-grown Scads or "Horse-Mackerel" were washed up on the beach on October 27th. This species is in no request as food at Yarmouth, and when the herring nets are hauled in they are invariably thrown back into the sea. Saw a flock of some 40 Snow-buntings pass the same afternoon.

On November 7th I obtained a very curious Red Gurnard, a freak. The lower lip was drawn back under the head until it was in the relative position of that of a Dogfish, the upper lip being in its normal position.

In the "bag" of a small Cuttlefish (*Loligo vulgaris*) whose body was but 1½ inches long, I found a young Herring 1¾ inch long, the tail protruding curiously out of the cephalopod's pouch.

November. All through this month the greatest number of Gulls I ever remember frequented Breydon in their intervals of pursuing the herring-fleet on the North Sea. Quite 7,000 Gulls must have swarmed the place on one occasion of my visiting it. These birds are most certainly on the increase.

November 18th. A Little Gull (*Larus minutus*) shot at the harbour mouth.

November 20th. Great numbers of Lapwings coming over with Wood Pigeons, Fieldfares and Larks.

November 23rd. Three Bean-Geese in the Market, from Breydon. There were five in the flock.

November 30th. Prodigious numbers of Linnets and other finches heading the Coast.

WINTER AND WILD BIRDS.

December 31st, 1906. After a long succession of "open" winters, something akin to the "old-fashioned winters" obtained during the last week of this year. On December 22nd, it rained heavily well into the night, next day snow began to

fall, and the birds to show signs of restlessness; the Black-headed Gulls had been for two or three days feeding and flying around the bridge in the heart of the town, a fairly good sign of the approach of a change of some sort. The morning of the 23rd dawned with a fiery glow in the west and snow began freely to fall. On the 22nd and 23rd flocks of various Wild Ducks were seen trooping along the coast making south, one bunch apparently of Mallard and Duck numbering quite 500; and a newspaper paragraph from Aldeburgh mentioned "Huge flocks of Ducks, Wild Geese, Wigeon, and other fowl continually passing south to sea-board, indicating a continuance of the present severe weather."

Such sights and reports naturally set every owner of a "hand-" or punt-gun to work, furbishing up his weapon, and laying in stores of ammunition. And Wild Ducks began straightway to fall to the guns of several frequenters of Breydon. Every amateur puntsman got afloat. I went down to Gorleston pier on the 27th, having heard that some Wildfowl were seen in the harbour, but saw none. A few score small gulls were floating on the ebb tide just off the pier, all the larger gulls having gone—somewhere, and few indeed were seen while the severity of the weather lasted. I noticed a few Thrushes and finches cross over the pier in that steady purposeful manner so common to them during the ordinary period of migration. On the 28th I crossed the North Denes, wading through deep snow, often tumbling into heavy drifts, for the undulations of the sand-hills were hardly traceable, and finally reached the sea-shore. A few out-flying *Turdidæ* and finches passed over me as I floundered through the snow: but when I reached the beach I found Thrushes, Redwings, Fieldfares, Linnets, Larks, Pipits, Twites, Goldfinches and, indeed, all kinds of small perchers flying due south, following the coast-line. Silently, like brown ghosts of birds they wearily flew—hour after hour—thousands upon thousands! Bunches of from five to fifty straggled and struggled along, odd birds, fagged quite out, alighting now and again to rest awhile. They passed almost within arm's length, some of them, and their line of flight lay between the

edge of the snow licked straight by the last flood tide and low water mark—some ten or twenty yards in width. I heard that for days birds had been passing, and what a host must perish!

The poor Black-headed Gulls fared badly enough. They left Breydon *en masse*, and betook themselves to the lower reaches of the rivers. I surprised thirty or more by running unexpectedly (to them) up the bank and put them to flight, momentarily from ink black sewage water running from a sewer outlet. They swarmed the outlying gardens, and alighted on the public roads: people fed them with crusts from the bridge—the kindly-disposed fed them on their very door-steps, near the Marine Parade. One would not get out of the way of a bicycle, and was ridden over unwittingly.

Two or three times I visited Breydon Walls during the continued snow and frost. Coots in miserable flocks slouched about on the mudflats, demoralised by incessant slaughter among their ranks. Parcels of wildfowl flew dejectedly to and fro; every man's gun was turned against them. "Strike" Sharman, remembering by-gone winters, was tempted again to visit the mudflats, and came home with the fore-deck of his punt covered with Mallard and Pochards. I visited his boat-shed on the 30th, and saw a row of Pochards and Scaups lying on a bench.

"That poor Crested Grebe," said he, "I picked up exhausted out of a hole in the ice; the tide had fallen, so it couldn't dive away, and it couldn't get on the wing."

On the 29th I had a look round the Saturday's market. On Edmond's (late Durrant's) game stall I saw a number of Mallard and Pochards, the latter, as they usually are, in excellent condition, "plump as partridges"; and a few bunches of Common Snipe hung there, too, they were fat enough, but scores had been turned away as thin and useless. On the country folks' stall were numerous Tufted Ducks, Pochards, and others—they had been having a fine time on some of the Broads, Hickling in particular, before the fowl were frozen out. Only one Jack Snipe was noticed in the market; but numerous bunches of Fieldfares, Thrushes,

Blackbirds, and other small birds were on sale, and found ready customers, which the wildfowl did not.

"So you've been killing your friends—the slug-eaters!" I said to a couple of different stall-folk, touching the dead Blackbirds with my finger.

"You'd think 'em friends if you saw 'em in the summer!" said one.

"You'd think so," said another, "if you was to see 'em among our fruit!"

And so vindictiveness had slain them, and petulance was exhibited in referring to them. And as Blackbirds are esteemed uncommonly good eating no mercy is ever shown them.

On the 30th, I dropped in on "Jigger" Hall, an intelligent engineer, who follows Breydon with a big gun "when there's anything about." He was just sitting down to dinner after a week's wild life on Breydon, sleeping at night in his houseboat, and returning home at intervals with his game, which had a fairly ready sale.

"I closed down [the engineering shed] for the Christmas week," said he, "and have had a week on Breydon—and haven't done so bad." Let me summarise his experiences.

He met with the first lot of fowl on the 23rd, getting several Mallard and 17 Coots. On the 24th he killed 25 Coots at one shot with the big gun, and obtained altogether two or three linen baskets full of these birds. There must have been nearly 3,000 Coots on Breydon; they kept much in a line like soldiers in a regiment (as I have seen them before), and fed ravenously on the roots of the *Zostera marina*, making quite an audible scrunching noise in their tearing of it up. A wretched adult Crested Grebe sat miserably bunched up on the ice, literally starving; he knocked it over with an oar.

About 60 Swans visited Breydon; Sharman killed three; Hall killed one, which he believed to be a Polish Swan; and gave me a fairly representative description of it. It was sold for eating as soon as it came home. The majority of the swans appeared to be Whoopers. Geese have been scarce; five

Brents were seen, and a Grey Lag Goose killed. Hall's game list for the week was as follows.:—

1 Swan	1 Teal (only one seen)
34 Mallard and Duck	1 Golden Plover
6 Pochards ("Pokers")	1 Crested Grebe
6 Wigeon	60 Coots

A few Golden Plovers hung about during the week, but were unusually shy. "Hard Fowl," *e.g.*, Golden Eyed, Tufted Ducks, and Scaups seen in small bunches, but they were shy and wary. So many Pochards have not been killed or seen for many years.

The few larger gulls remaining here were seen chasing unwounded Dunlins whenever they flew near them, but these quick-turning little birds were too swift for them. The Hooded Crows forsook Breydon and the marshes and kept to the open river and shore. I saw a dead gull clean-picked by them—as much of it as was not frozen into the ice on a ditch.

Kingfishers have been seen miserably sitting about on posts and rails, looking abject in their hunger; and even those who have little pity, were sorry for their plight. One came and tapped on the window in Hall's houseboat; seeing the light through it, it might possibly mistake it for an open archway. While out shooting on one occasion, he left the door of the houseboat open, and a Wagtail that had been hanging around for scraps went in and cleared the fragments off his dinner-plate, and when killing a wounded Mallard by cutting its throat, so as not to damage its neck (as wringing it will sometimes do), the blood dripped and congealed on the snow on the forepeak of the punt, a hungry Starling flew down on the boat and ravenously ate the crimsoned snow, and when driven away, returned again and ate more of it.

Hall said the 23rd was "a wildfowl day beyond all memory." Some small return bunches visited Breydon on the 28th and 29th. The ice formed so rapidly on the night of the 29th that he had to return from the drain to his houseboat, having no ice-hook to cut a way through, but on the 30th he managed to cut his way out to open water.

Mr. J. H. Gurney wrote me on December 26th and remarked on "flocks of Skylarks going seawards." He saw 20 Rooks that day eating a dead sheep.

The Rooks round about Yarmouth kept much to the various outlying gardens, and when not progging for a morsel, sat disconsolately on the topmost twigs of small trees surveying the miserable outlook. They hunted singly. Chaffinches fared badly, and looked the most abject of all the finches; one on the 27th, as I stood near a rail on Breydon Walls, came to within ten inches of my foot to search a tiny patch of bare soil. The Meadow Pipits seemed fairly merry, and hunted most of the time on the weedy edges of Breydon, and along by the river margins.

Many wildfowl were observed on the rivers; and at St. Olaves some good bags were made; one gunner shot a female Goosander, and three Dabchicks were killed—for no possible useful purpose. In the neighbouring villages all the berries have been stripped from the hedgerows. Two Snipe wandered into a cattle shed on the marshes, where among the stable refuse they probed and prodded in hope of finding some stray grub or worm; their footprints in the snow led to their discovery, but both happily escaped.

Wild Ducks were plentiful enough on Fritton Lake, and big takes were made at the decoys, as many as 700 birds I am assured were taken therein in one day. To certain ditches round the west end of Caister, on the edge of the marshlands, ducks persistently resorted, and afforded one individual who, since the conclusion of the herring voyage just before Christmas, has done nothing but shoot in that particular neighbourhood, unusually good sport. I am told on very good authority 70 ducks fell to his gun. On one occasion he secured a Mallard in a most unexpected manner; hearing an unusual clamour among some tame ducks kept hard by, he went out to see the reason of it. To his astonishment he at length discovered a Mallard sitting on the ridge-tiles of an adjoining house. It was but the matter of a few moments to slip back for his gun, and on his prompt return he shot at and killed that venturesome Mallard.

When skinning a couple of Coots after they had been feeding about a fortnight on the *Zostera* I found them exceedingly plump and fat, their gizzards contained long blades of the "grass" doubled up, and much fine gravel. The intestines were packed with well-digested "grass."

January 5th, 1907. Yesterday a fine female Goosander was brought to me for identification; it was shot at Buckenham, where fowl during the past two or three days have been abundant. A few Goosanders and Smews—"Sawbills," that visit us in any numbers only in very severe weather, appear to have kept off Breydon, although some Smews visited the upper parts, and frequented the rivers.

I went in the afternoon to Belton and St. Olaves, and had a chat with one or two of my friends who like to watch birds preferably down the sights of a gun. In the wash-house of one hung some Coots and ducks, and a bunch of Snipe—4 Common and 2 Jacks. A young urchin who had just left school to work in a cowshed passed his noon hours during the bad weather near a ditch frequented by Snipe. He obtained three or four small spring traps, and placed them in the water near where he saw footprints: these Snipe were the bag made by him in a very short period of time. The boy's father, Mr. Brooks, assured me that *thousands* of Snipe came to the marshes just before the snowstorm: and they haunted also the ronds or saltings. They were so put about by its continuance that seven were seen with Dunlins on the mud-flats.

Brooks assured me he might have shot a pair of Smews on the river at Burgh, but being eager to secure a Mallard swimming by, in the end missed them all. Several Dabchicks frequented the river there. Geese in flocks of 17—12—13—and 10 respectively, mostly a "dark greyish sort" (probably Bean Geese), the most common species here this winter) passed over, and a large hawk (which I have reason to believe was a Buzzard) flew out of a stack-yard with straws depending from its feet; and I have no doubt a rat was mixed in amongst them. A large "cloud" of Wood Pigeons containing some hundreds passed over from the direction

of Yarmouth, where another acquaintance of mine saw them a little earlier on the same date—no doubt the same flock.

To-day I saw three birds feeding near Breydon which I at first believed to be Meadow Pipits. On putting them to flight, which they appeared very reluctant to do, I noticed an uncommon amount of white on the two outside feathers on either side the tail. It struck me at the time as being rather unusual; but not being prepared to suspect anything rarer, I paid no more heed to them, and let them go.

On taking up the 'Zoologist'* of December, I happened to read an article on the Water-Pipit, and further reference to Saunders' 'Manual' I was astonished to find how curiously my birds corresponded with the descriptions there given of that species. I have been back to the spot since then, but, as I was prepared to be, was disappointed at not again meeting with these birds. Cautiously introducing the matter and my suspicions to an old and observant gunner, he strangely enough spoke of seeing *three* birds a few hours previously at the harbour mouth near the piles of the breakwater, which he noticed "carried more than usual" white on their tails. There the matter for the present must end, for were I to describe the species to any of those who prowl around with guns searching for "specimens" not a Meadow Pipit or Rock Pipit would escape the general massacre "rarities" provoke. A "new species" had better remain unidentified, and may, as far as I am concerned in the matter, however valuable it might be.

January 12th, 1907. The weather and bird-life generally have for the nonce returned to the normal. To-day's market was comparatively bird-less. Only on one stall was there evidence of anything unusual; a haberdasher named Young (the hero of the Red-Crested Whistling Ducks) had suspended, amid stockings and underclothing, a large display of Coots, tied in couples, which he was selling—and freely too—at sixpence the brace. I found they were exceedingly plump and in good condition; and he informed me that they seemed loth to leave the "grass" to go back to the now ice-free

* Article on "The Water-Pipit (*Anthus spipoletta*) as a visitor to England," by Michael J. Nicoll, F.Z.S., M.B.O.U.

Broads. He pulled some fronds of *Zostera* out of the mouths of some which he had shot in the act of feeding. Thirty-eight birds were the result of one punt-gun discharge. I have before noticed how loth these birds are to leave the beds of *Zostera* when they have once obtained a taste of it. Mr. Young also shot a Shag, a most unusual visitor to Breydon, particularly at this season of the year.

The Gulls have now betaken themselves to their usual haunts, a few only frequenting the river in the neighbourhood of the town, and these the Black-heads. During the continuance of bad weather these birds made themselves extremely conspicuous in the heart of the town. An old lady took a parcel of hare's bones, broken pudding, and vegetables to the St. George's Park, where they assembled in numbers. There was a noisy squabble both on the ground and a-wing over these coveted fragments, and Woods, the park-keeper, after they had devoured the softer morsels, smashed up the bones, and in a very short time they had devoured all the pieces. They visited the gardens all round the Park and begged of the householders. As usual the greatest sufferers appear to have been the Redwings, a fact remarked on by several observers who, like myself, came to the conclusion that extreme cold, as much as shortness of food, seriously affects this species, and it was noticeable, too, how, in an unusually short time they drooped and died—while in more protracted frosts without so much snow, in other years, they did not so soon succumb. Some were found dead at Filby, at Belton, and indeed in most of the villages round. Some Chaffinches were also picked up dead. But Larks, as they usually do, took to the cabbage gardens, and fed freely on the cabbages, to the undoing of the gardener, and in many instances to their own.

XVII.

ON THE EARLY STAGES IN THE LIFE HISTORIES OF CERTAIN FRESH-WATER FISHES.

By Frank Balfour Browne, M.A. (Oxon.). F.R.S.E.
(Director of the Sutton Broad Laboratory.)

Read 30th October, 1906.

During the Spring of 1903 I was partly occupied in watching the breeding habits of the fishes in the Sutton Broad, and in each succeeding year I have continued my observations when time has allowed. I made careful drawings and notes of the eggs and larvæ of those species which came within my notice.

So far as I have been able to ascertain, very little attention has been paid to the early stages in the life history of any of our fresh-water fishes, references in books being of a more or less general and vague character; and it has occurred to me that it may be well to put on record the few facts which I have observed and to give some illustrations of the eggs and larvæ as has been done in the case of many of the marine species of fishes.

My observations have been upon only six of the fresh-water species and in one of these cases I only obtained ripe unfertilized eggs.

The eggs of all fresh-water fishes are demersal and of the majority are strongly adhesive, sticking to the water plants, &c., amongst which they are deposited. In some cases, as in that of the Perch, the eggs are laid in long tangled skeins, which are deposited in such a manner as to become twisted round water plants, &c., and in such cases the eggs are non-adhesive. The eggs of such species as the Salmon and Trout

are deposited singly and they are smooth and non-adhesive, being buried amongst the gravel in clear water.

The period between the fertilisation of the egg and the hatching of the larva varies considerably among the fresh-water fishes ; the eggs of the Pike for instance hatch in about 10 or 12 days whereas those of the Trout or Salmon take from 80 to 100 days, and even longer before hatching. The condition of the larva when hatched also varies considerably. The Trout or Salmon hatches out as a highly pigmented opaque alevin with a large yellow or orange yolk sac attached to it, while the Perch hatches out as a transparent larva invisible but for two large dark eyes. Thus there is considerable variety in the early stages of fresh-water fishes, the various differences being associated with differences in habit. Coming now to the particular species which I have had the opportunity of observing :—

The Pike (*Esox lucius*), according to authorities, breeds in March and April, sometimes as early as February. The earliest record which I obtained at Sutton was March 14th, 1903, when I obtained a small ripe female fish. On several occasions I obtained ripe male and female fish at the same time and fertilised the eggs by what is called the dry process in Salmon and Trout culture. The eggs were expressed from the female fish into a dry basin and the milt from the male was expressed over them—water was then added, and the whole thoroughly shaken up. In the meanwhile most of the eggs had adhered to the basin and after being allowed to remain for a few minutes the water was poured off and fresh water added, the eggs being thoroughly rinsed. They were then gently removed one by one from the basin and allowed to sink on to water plants, to which they at once adhered, in the aquaria where they were to develop.

The egg of the Pike is large and easily recognised. It measures about 3.0 mm. in diameter, and is of a pale yellowish colour and contains scattered groups of minute oil-globules, giving it some resemblance to the egg of the common Sole (*Solea vulgaris*).

About the 10th day after fertilisation the eggs hatch, the opaque yellowish larvæ from 7.0 to 9.0 mm. in length, being

very unlike the mature fish. The eyes show a little pigment and a few black chromatophores are scattered over the body chiefly in the dorsal region of the gut and on the head. Immediately after hatching, the larvæ take up a perpendicular position upon a leaf or stem of a water plant, and lie quite motionless with the head upwards as if holding on by means of a sucker under the chin. This period of rest in every case

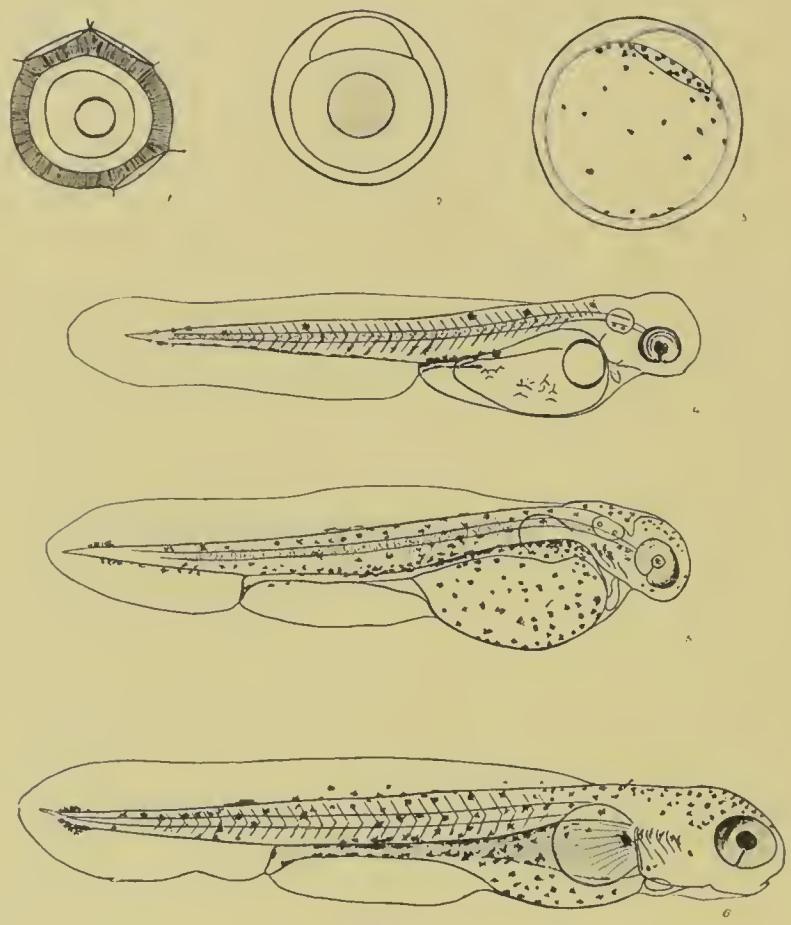

PLATE I.

lasted about 9 days. If disturbed during this period, the larvæ showed great momentary activity, darting rapidly about and then taking up a similar resting position on some other leaf. About the 9th or 10th day the little fish commenced an active and voracious existence. They were always to be seen poised in the water in a horizontal position, their pectoral fins beating vigorously and their tails quivering

almost imperceptibly. When first hatched the heart is in a perpendicular position and the blood is colourless, but after a few days the heart becomes horizontal and the blood red.

The growth and development of the young fish in the aquarium was fairly rapid. Their food from the first apparently consisted entirely of Entomostraca, and they attacked and successfully engulfed fairly large daphnids. When 9 days old their length was from 11 to 13 mm., and in 21 days they had increased to from 16.0 to 19.0 mm., and they were by that time easily recognisable as Pike, having developed the large jaws and peculiar shaped head of the adult. At this stage also the paired ventral fins are visible in a rudimentary condition, and the rays of the dorsal and anal fins are in process of development. The tail also is in the heterocercal stage, the two sets of 8 rays representing the upper and lower halves of the adult fin being clearly recognisable below the upturned notochord. The larval fins are still present but are very ragged in appearance as if they were fraying off.

At the age of about 6 weeks the process of development is almost complete, the fish being about 30 mm. ($1\frac{1}{8}$"–$1\frac{1}{4}$") long. Owing to their immense appetites it was not considered advisable to keep these fish longer in the aquarium. In one experiment, however, two were retained until the middle of August when they were about 5 months old, and they had then attained a length of about 3 inches (75.0 to 85.0 mm.). Judging from the fact that a number of young Pike caught in August and September measured from 75.0 to 95.0 mm. in length, the development of the aquarium specimens would appear to have been about normal.

As to the rate of growth beyond the first season almost nothing is known. We have tried the experiment of marking Pike with silver labels and releasing them in the hope of their being recaptured; but, although we have so marked between 30 and 40 fish of various sizes and have advertised the fact throughout the district, none of these fish have been recovered, so far as I know, except five which we have retaken ourselves in the Sutton Broad. We cannot, of course, learn much as to the growth or migrations of the Pike from that amount of material, but it is interesting to notice that all five fish were

originally caught in the Broad within perhaps 300 yards of the Laboratory, and that they were all retaken within the same area. Two cases are of some interest as indicating a homing instinct in the fish. A large Pike 33½ inches long was captured on February 1st, 1905, on a set line at a certain place on the Sutton Broad. It was carried in a boat to the Laboratory Staithe and deposited for some hours in a fish trunk in the water. It was then marked and released at the Staithe. On February 10th it was retaken on the same line on which it was originally caught, having found its way out of the shallow dyke at the Staithe into the Sutton Channel, where it turned to the left and travelled about 100 yards, after which it turned to the right in amongst the reeds and travelled 20 or 30 yards to where the line was set.

A similar case occurred in the autumn of last year where a small fish was taken on a spoon bait about 200 yards up the Sutton Channel and was brought to the Laboratory Staithe in a boat and then marked and released. After 16 days it was recaught at the same spot where it was originally taken. These two cases at least suggest that each fish has a definite beat which it patrols.

I give a list of the recaptured fish from which it will be seen that their growth between the time of marking and recapture was very small. I should have expected the smaller fish to show the most rapid growth, whereas the largest of the five added more to its length than the others, the smallest fish adding the least. However, criticism of so small an amount of material is useless and I only give the list as a statement of fact :—

Mark.	Date of Release.	Length when Released. Inches.	Date of Recapture.	Length when Recaptured. Inches.	Increase in Inches.	Time between Release and Recapture. Months.
T 92	Apr. 11,04	19	Feb. 18,05	19½	½	10
T 76	,, 11,04	23	Dec. 5,04	23½	½	8
T 56	,, 11,04	24¾	Apr. 15,05	26	1¼	12
T 17	,, 22,04	25½	Dec. 7,04	26½	1	8
T 34	,, 11,04	27	Feb. 18,05	29½	2½	10

The Perch [*Perca fluviatilis*]. Whereas the Pike is from the first a solitary fish, the Perch is gregarious. Shoals of Perch are common sights in rivers and on lochs where, when the water is still the fish can be seen sporting on the surface almost like mackerel. The eggs also are laid in long tangled skeins amongst the water plants where they look, as some one has suggested, not unlike strings of pearls.

The spawning period of the Perch is from March to May and the eggs are easily found in the River Ant and in the dykes communicating with it. The egg which measures from 1.7 to 2.0 mm. in diameter and contains a large colourless oil-globule about .6 of a millimetre across, is enclosed in a dense capsule about .3 of a millimetre in thickness which, under the microscope has a striated appearance, the striæ radiating outwards. The surface view of the capsule shows a finely pitted appearance, suggesting that the striæ may be fine channels allowing the water to pass in after the egg has been deposited. A portion of the egg-band examined immediately after extrusion shows that the yolk and the capsule are in close proximity at all points. After a few hours, however, there is a distinct space between the yolk and the capsule, the egg having become turgid by the absorption of water.

The larvæ hatch out in about 14 days, and are almost invisible, being quite transparent except for the large dark eyes and a few dark chromatophores. The large oil-globule lies anteriorly in the yolk which shows segmentation. Within 24 hours of hatching the larvæ measured from 5.0 to 6.0 mm. in length, and apparently immediately commenced a gregarious existence as they crowded together in the aquarium. The pectoral fins were at first not noticeably large, but they seemed to grow very rapidly and were apparently much used, as the fish are very active. In from 10 to 14 days the yolk sac was absorbed, the air bladder had appeared, and the black chromatophores had increased in number, being thickly grouped along the dorsal region of the gut, a few being scattered over the head and body. The dorsal fin was just beginning to appear, and in the more advanced specimens

the posterior end of the notochord was just turning upwards, the thickening below being visible. I never succeeded in keeping the larvæ alive in the aquaria beyond this stage, conditions which were quite suitable for the larval Pike, Roach, and Stickleback being unsuited to the larval Perch. At this stage the fish was very long and thin, and the pectorals very large, and I should imagine that this species,

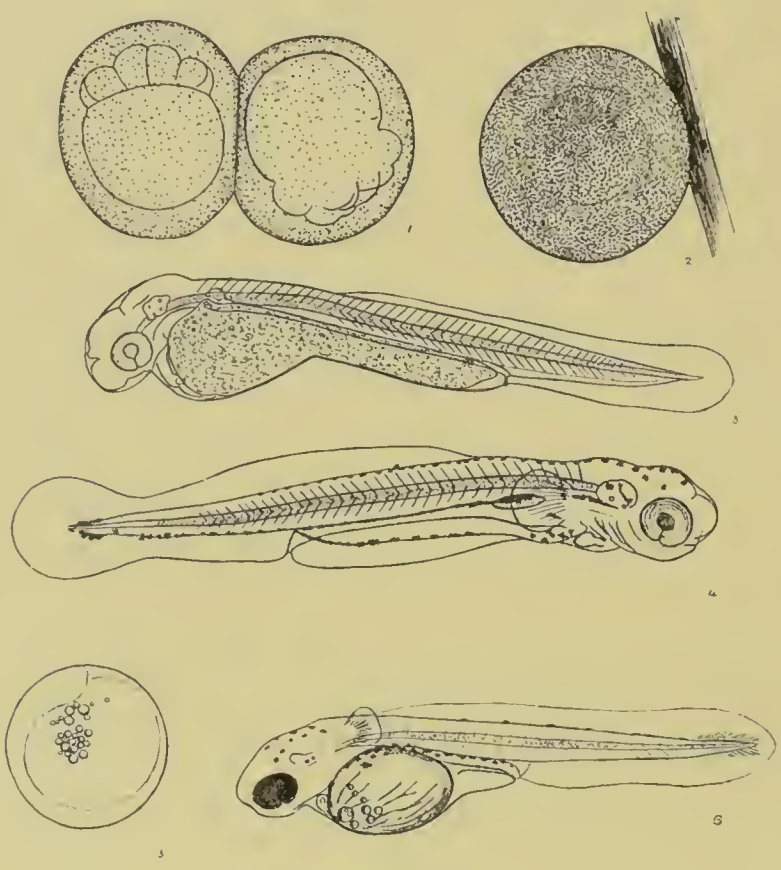

PLATE II.

unlike the Pike, Roach and Stickleback which skulk amongst the water weeds, swims in the open channels, its remarkable transparency supporting this idea.

The other fresh-water species of the Perch family, the Ruffe or Pope (*Acerina cernua*), I was unable to rear as I never succeeded in finding the eggs in nature, and I did not manage to obtain a ripe male at the time I had a ripe female. I only

once found the latter and succeeded in obtaining eggs on slight pressure. The eggs after a few hours measured about 1.4 mm. in diameter and are easily identified by a large orange yellow oil globule about .55 mm. which lies in or on the yolk. In the eggs of this female the surface of the capsule was delicately vereegned and irregularly striated. Day and other authorities refer to the "straw-coloured" ova of this species, and Seeley ('Freshwater Fishes of Europe,' p. 36) says that the eggs are laid "in connected strings like those of the Perch." I am quite satisfied that in the particular fish I examined the eggs were independent of one another, but whether or not this was an exceptional case I am not in a position to say.

The Bream (*Abramis brama*) breeds in May and June, and I obtained ripe fish in the Sutton Broad from May 25th to June 29th, 1903. The eggs are about 1.0 mm. in diameter, and there is no oil-globule. The surface of the egg-membrane is finely and closely pitted and is strongly adherent, so that the eggs become attached to the water plants amongst which the fish spawn. The yolk is of a pale yellowish colour.

The larvæ which hatch in 7 or 8 days are about 9 mm. in length, and are pale yellow coloured having very few, if any, black chromatophores and very faint pigmentation in the eye. The yolk sac, containing very granular yolk, instead of being more or less oval as in the Pike and Perch and many other fishes, is flask shaped, the neck of the flask being towards the tail of the larva. The larval fin is not largely developed and there is apparently no præanal fin.

In the case of the Roach (*Leuciscus rutilus*) the eggs, which are laid about the same time as those of the Bream, are to be found in abundance on the weeds at the side of the Stalham channel, and also along the sides of the River Ant. Like the Bream, this species spawns in shoals, and the spawning fish can be seen from a considerable distance as they greatly disturb the surface of the water. The egg, which is of a pale greenish colour, is about 1.9 mm. in diameter, and there is no oil-globule. There is apparently a large perivitelline space, as the outline of the yellow yolk can be seen through

the rather thick capsule which is covered with small tubercles.

The eggs hatch in less than 10 days, but I was not fortunate enough to notice the newly hatched larva. My illustration is of a fish which has been hatched at least three days, as the heart is in a horizontal position, and the yolk sac is almost absorbed, and the gills and mouth are developed. The yolk sac in the newly hatched larva was apparently flask shaped as in the Bream.

Lack of time prevented my paying further attention to these two species which were left to themselves mixed in an aquarium. After a fortnight the Bream had all disappeared, but most of the Roach survived until August when they were set free in the Broad.

The only other species which I hatched and reared was the Nine-spined Stickleback (*Gasterosteus pungitius*) whose eggs, and those of the three-spined species (*G. aculeatus*), are to be found in the dykes from the end of March until the beginning of June. The eggs are adherent in a mass, and are deposited by several females in a nest constructed out of water plants by the male, who also guards the eggs until they are hatched.

A Stickleback egg measures about 1.5 mm. in diameter, and contains a number of small colourless oil-globules. I did not try to obtain eggs from the females although ripe fish of both sexes were easily obtainable, but I obtained any number of eggs in which development had only just commenced. Such eggs took from 12 to 20 days before the larvæ hatched. The newly hatched larva which measures about 4.9 to 5.0 mm. in length, is colourless except for a few black chromatophores on the head and in the dorsal region of the gut. There are also 7 or 8 well marked pigment patches along the dorsum which together with some on the gut appear pale yellow when viewed by reflected light. The eyes also are well pigmented from the first.

The yolk sac presents a striated appearance owing to the presence of numerous blood vessels which at first contain colourless blood. These vessels all converge towards the anterior and lower end of the yolk sac and pass forwards to

the heart, and the blood can be seen in them flowing downwards and forwards. No doubt they assist in the absorption of yolk as in the case of the Salmon alevin.

In the batch of larvæ which I kept under observation the yolk was not completely absorbed until after about three weeks, by which time the rays of the dorsal and anal fins were just becoming visible, and the rays of the caudal fin were developing beneath the end of the notochord which had not yet commenced to bend upwards. The little fish had gradually become thickly covered with dark chromatophores, but were still fairly transparent. Between 4 and 5 weeks after hatching the fish was easily recognisable as a Stickleback, although development was not complete. The caudal fin was in the midst of the heterocercal stage, the rays of the dorsal and anal fins were well developed and the spines on the back were visible as little protuberances in front of the dorsal fin. The larval fin had to a great extent disappeared. About a fortnight later most of the fish had taken on the adult appearance and metamorphosis was complete.

These observations were made during the course of other work, so that it was not possible to devote much time to them. No efforts were made to keep the various species alive in the aquaria beyond supplying them liberally with cladocera as food. The Pike, Roach and Stickleback survived without any difficulty, and although my observations as a rule were not repeated, I reared the larvæ of these three species on several occasions. The Perch never survived more than about 14 days: the complete absorption of the yolk sac being always the finale of its life-history in the aquaria.

I only hatched the eggs of the Bream once, as only once did I obtain a ripe male and female at the same time. I should have expected the Bream to survive as readily as the Roach under similar conditions, but possibly my specimens were handicapped in some respect.

The Sticklebacks and Roach lived together on peaceable terms although the former always seemed better fed than the latter. The Pike after their period of rest attacked and as a rule swallowed any other larva placed in their aquarium.

For some time I fed them almost entirely upon Perch larvæ, of which I had a large supply, and they seemed to thrive very well on them. Pike of 25 and 30 mm. had no difficulty in disposing of larvæ of 10 and 15 mm., and, from the way their own numbers thinned down, I fancy that they must have successfully despatched their own smaller brethren although, strange to say, I never saw them attack one another.

There are other species of fish, such as the Rudd, and Tench which inhabit the Broads, the early stages in the life-histories of which have not, so far as I am aware, been investigated. I believe that there is enough to be done in watching the development of any single species to occupy a Naturalist for a whole season. What I have described in the present paper are merely a few facts observed during the course of other work, and I hope that they may serve to direct the attention of others to the life histories of our fresh-water species.

DESCRIPTION OF PLATES.

PLATE I.—

1. Egg of *Perca fluviatilis*, the Perch.
2. Egg of *Acerina cernua*, the Ruffe or Pope.
3. Egg of *Esox lucius*, the Pike.
4. Newly hatched larva of *Perca fluviatilis*.

5, 6. *Esox lucius*, newly hatched and 9 days old.

PLATE II.—

1. Egg of *Abramis brama*, the Bream.
2. Egg of *Leuciscus rutilus*, the Roach.
3. Newly hatched larva of *Abramis brama*.
4. Larva of *Leuciscus rutilus* several days old.

5, 6. Egg and newly hatched larva of *Gasterosteus pungetius*, the nine-spined Stickleback.

XVIII.

AN ENTOMOLOGICAL VISIT TO HUNSTANTON.

By Claude Morley, F.E.S., etc.

Read March 26th, 1907.

Many Entomologists have, at various times, visited the only western watering-place on the East coast, but none have been of that omnivorous sort which takes everything that crawls or flies; and it may, consequently be of interest to the Society to have upon record a few of the great crowd of uncommon species met with by Mr. Ernest A. Elliott, F.Z.S., F.E.S., and myself during a week's stay there last August. We had put up for a night at King's Lynn on the 17th, in order to learn what Mr. Atmore could tell us of the insect produce of the Lincolnshire coast thereabouts; but a hard day's collecting from Sutton Bridge, Guy's Head, Gedney Drove, Leamlands, &c., to Long Sutton produced so little and we found every inch of the rich alluvial soil so assiduously cultivated, that we returned in disgust to Norfolk, with none of King John's nor any other kind of Jewels!

On the rank grass on the bank of the Ouse during a shower at King's Lynn, we found *Microgaster sticticus*, *Dolichopus griseipennis*, *Platychirus clypeatus* and a few Anthomyids: but our collecting really began on the 19th when we got to Holme-juxta-Mare, as the Rev. William Kirby, M.A., F.R.S., termed it on the occasion of his visit to the spot, where he first found *Apion limonii* in the world in about the year 1800. Our primary object was, of course, this beautiful Apion, whose home is an extensive salt marsh about half a mile long and some 200 yards broad, covered at that time with flowers of the Sea Lavender (*Statice limonium*): and here we had the

pleasure of taking a nice series each, though perhaps a little early, since some of the beetles were hardly mature (*cf.* my notes, Entom. Monthly Mag., 1906, p. 229). It was best found by lying flat on the damp mud and searching at the roots of the plants, and with it we noticed many *Dyschirius salinus*, *Bembidium normanum*, *Homalota fungi*, a couple of *Seymnus*, *Cortiearia lardarius*, *Thyamis lurida*. *Apion pisi* and, far below high water mark, *Cassida vittata*, Vill. *Anisotoma dubia* was swept from marram grass; and we also noticed *Hydræcia nietitans*, *Cryptus viduatorius*, *Bassus lætatorius*, *Lissonota parallela* and *L. bellator*, *Chelonus oculator*, *Perisemus triareolatus*, *Lasius niger* var. *alienus* and *Colletes succinctus*, of which half a dozen males were clinging together to a stem of the marram grass. Many nice Hemiptera were about, such as *Chorosoma schillingi*, *Piesma capitata*, *Salda pilosa*, *Liburnia aubei*, *Doratura stylata*, *Aeocephalus albifrons*, and *Cicadula fasciifrons*. The handsome *Asilus crabroniformis* was swept from rushes, *Philonicus albiceps* flying on the sandhills with *Nemotelus uliginosus*, *Sphærophoria flavicauda*, *Balioptera tripunctata* and *Meromyza pratorum* at the roots of grass.

The next day we visited Heacham in a gale of wind and met with *Atractodes vestalis* and a *Callimone* in the celebrated chalk-pit, together with *Ophion obscurus*, *Spheeodes affinis*, *Athysanus communis* and *Cicadula sexnotata*. Whitethorn produced *Monanthia dumetorum* and the salt marshes, where was plenty of Lavender though none of its Apion, were reluctant to yield the marsh variety of *Aeocephalus albifrons*, *Nemotelus uliginosus*, *Tephritis plantaginis*, a *Scymnus*, and a couple of *Stenobothrus bicolor*. In the chalk-pit, referred to, were *S. elegans*, *Thyamis jacobeae*, the scarce *Meligethes fulvipes*, and a single *Oncomyia atra*.

The Ringstead Downs, which are the two sides of a steep chalk gorge, were alive with insects on 21st. I took *Pimpla brevicornis*, *Chelonus oculator*, *Macroccntrus marginator*, *Syrphus balteatus*, *Calliphora azurea*, *Olivieria lateralis*, *Meromyza pratorum*, with other Diptera; both sexes of *Lycæna corydon* were common as also were *Stenobothrus*

parallelus and *S. bicolor*, while in Ringstead village *S. rufipes* occurred on Malva, as did *Podagrica fusciornis*, *Apion malvæ*, and *Aneurrhynchus galesiformis*, Westw. One male *Bruchus cisti* and *Haltica pusilla* were the best Down Beetles, though *Apion seniculum* and *Trachyphlœus scabriculus* also occurred there on Helianthemum, with *Berytus signoreti*, *Piezostethus galactinus* and *Liburnia pellucida*. On the way home we found *Lissonota cylindrator*, *Salius exaltatus*, *S. parvulus*, and *Pemphredon lethifer* on flowers of Fennel at Old Hunstanton; and *Coccinella* 11-*punctata*, *Heterocerus lævigatus*, and a few more *Apion limonii* at Holme.

A lazy hour at the latter locality, sitting on the sand hills on 22nd, was productive of one or two nice things, though a sharp shower ended the collecting abruptly. On the marram grass were *Rhogas circumscriptus*, a female *Limneria*, *Orthotylus rubidus* var. *Moncreiffi*, a few *Eristalis tenax* and *Olivieria lateralis*, a spotted-winged *Scatella*, and a single specimen of *Phaleria cadaverina* on the edge of the beach; a few more *Apion limonii* and *Mecinus pyraster* on Lavender, along the landward fringe of which were flying the rare *Agdistes Bennettii* and *Gelechia suædella*, with *Luperina testacea*, *Eupithecia centaureata* and lots of *Crambus geniculatus*.

Early the next morning several Ichneumonidæ, including the common red *Ophion luteus*, were found on house windows in Hunstanton, probably attracted to light the preceding night; then we paid another visit to Ringstead Downs, with the object of working a young hazel copse on the top of the gorge. The result was not exhilarating, though *Cratichneumon annulator*, *Phæogenes argutus*, *Diadromus collaris*, *Glyphicnemis brevis*, *Pezomachus intermedius*, *Atractodes exilis*, a *Porizon*, a *Cteniscus*, and *Lissonota sulphurifera* fell to our nets: with the Braconids: *Bracon stabilis*, *Meteorus albiditarsus*; and *Halictus fulvicornis*. Only *Dicyphus globulifer*, *Malacocoris chlorizans*, *Psallus salicellus* and *Deltocephalus socialis* represented the Hemiptera: three male *Bibio clavipes*, *Epitriptus cingulatus*, *Hybos grossipes*, the nice *Platypeza infumata*, a *Pipunculus* and *Ascia podagrica* were among the Diptera, which also comprised *Dryomyza analis*, *Hylemyia*

strigosa, *Sepedon sphegeus*, *Sciomyza cinerella*, several *Helomyza variegata*, *Sapromyza rorida* and *Phora incrassata*. *Stenobothrus parallelus* was again met with, though more sparingly than on 21st; and only one *Psocus variegatus* turned up on hazel. *Malthinus balteatus* on hazel, one female *Bruchus cisti* on Helianthemum, *Atomaria analis*, *Thyamis atricilla*, *Apion nigritarse*, *Orchestes rusci* and *Ceuthorhynchus contractus* represented the Beetles.

On the 24th, were swept at Burnham Thorpe, from very wet herbage, *Atractodes exilis*, *Pimpla graminellæ*, *Chelonus inanitus*, *Halictus minutissima*, *Bibio clavipes* and the common *Platychirus manicatus*. On the way back, through Docking, we found that sweeping herbage while riding along (on bicycles) produced some nice insects, such as *Lissonota cylindrator* and *Pæciloscytus unifasciatus*, while common things, like *Syrphus ribesii*, *S. corollæ*, *Platychirus manicatus*, *Chilosia variabilis*, *Eristalis tenax*, *E. arbustorum*, *Lucilia sericata*, *Olivieria lateralis*, *Caricea tigrina* and *Sapromyza rorida*, choked the nets.

On the whole, we were strongly of the opinion that both Holme and Ringstead were localities worth bearing in mind for future investigations, perhaps earlier in the year; but that the remainder of the country which we traversed from Sandringham to Burnham Market, was too much of the usual "East Anglian" type to afford us, who are so well accustomed to it, many opportunities of enriching our collections in the casual way of "general collecting" which was all we pretended to be doing last August.

The following day we left for Ely, and in the evening took a Deltocephalus, new to Britain, at Brandon.

N.B.—The *Scymnus* taken at roots of *Limonium statice* at Holme on 19th is the quite newly discovered *S. Limonii*, Don. (*cf.* Entom. Record, 1903, p. 287), which had only hitherto been taken at Yarmouth in the Isle of Wight.

XIX.

MISCELLANEOUS NOTES AND OBSERVATIONS.

Wild Bird Protection on the Norfolk Coast.—It is with great pleasure that we have again received excellent reports from the Secretaries of the various Bird Protection Societies of the valuable work carried on by them on the Norfolk coast.

Wolferton Wild Birds Protection Society.—Mr. George Cresswell, the Hon. Sec. of this Society, which is under the patronage of H. M. the King, writes that the season of 1906 has been the best yet recorded: all the birds showing a marked increase. The Common Terns have nested in large numbers, and the colony of Lesser Terns has largely increased. These beautiful birds being in much greater numbers than heretofore. The Ring Dotterels have not only increased in numbers on the protected ground, but have spread to other parts. The Sheld-ducks have increased in number, and Wild Ducks, and Shovellers have also nested in numbers. When we compare this state of things with the melancholy account of the devastation to which the two species of Terns and the Sheld-duck were formerly subjected in this district as set forth in the 'Birds of Norfolk,' one cannot but rejoice at the rescue of these beautiful birds from the destruction then impending, and all this has been effected at the trifling outlay in money of £15.

Blakeney and Cley.—Mr. Quinton E. Gurney reports that the season of 1906 was on the whole a very satisfactory one, notwithstanding spells of very unfavourable weather. The Terns' nests, especially those of the Lesser Tern, again increased, not only in number but in the extent of ground they covered. The following amongst other interesting notes are from the Diary of the watcher.

April 16. Found a Ring Dotterel's nest with eggs.
,, 20. Saw the first Lesser Tern, somewhat earlier than usual.
,, 28. Common Terns arrived on same date as for the last three years.
May 13. Clutch of 12 young Sheld-ducks hatched out.
,, 21. Several Lesser Terns' and Ring Dotterels' nests with eggs.
,, 24. Common Terns with eggs.
,, 27. Oyster-catcher's nest with three eggs.
June 8. First Lesser Terns hatched.
,, 20. Common Terns hatching.
,, 25. Oyster-catcher hatched.

The sum subscribed amounted only to £7 4s., and the balance sheet shows a debt of £1 2s. 6d., which is greatly to be regretted.

Wells Wild Birds Protection Society.—Mr. C. A. Hamond reports that the season at Wells was on the whole a satisfactory one notwithstanding the heavy storm on June 28–29, which killed a great many young birds, but the old ones nested again and hatched many late young ones safely. One particularly interesting feature in his report I quote in Mr. Hamond's own words: "The return of the Black-headed Gulls to their old grounds is most interesting, they are nesting in the very piece of marsh which is known as 'Mow Creek' by the old Wells gunners (*c.f.* 'Birds of Norfolk,' vol. iii. p. 331) after having been dislodged as a breeding species for nearly 70 years"; this is most encouraging and

we cannot but sympathise with Mr. Hamond's sanguine hope that "if our East Norfolk Naturalists can see their way to a thorough protection of the old breeding-grounds, we may again be able to count the Spoonbill, Avocet, Ruff, and Black Tern among our breeding species," but if this "thorough protection" is to be accomplished the Societies in question must meet with more liberal support, for the sum at Mr. Hamond's disposal only amounts to £7 10s.*

The following interesting particulars are from the watcher's diary.

In 1905 two Black-headed Gulls nested here, in the past year (1906) five pairs have nested and safely carried off their young.

May 24. Saw first Common and Lesser Terns' eggs. Up to
,, 31. not many birds nested on account of cold, but by that time most of the Redshanks were hatched.

June 4. Some Terns setting.
,, 5. Saw a clutch of eleven young Sheld-ducks, also some Ring Dotterel with young.
,, 12. Two lots of young Sheld-ducks and young Redshanks could fly.
,, 14. Watched a Roseate Tern for an hour.
,, 20. Saw first clutch of Lesser Terns.
,, 21. Saw several Common Terns hatching! from this day they were hatching every day up to
,, 29. When a strong N.E. wind and heavy rain killed a good many young.

July 8. Terns which had lost their young laying again, till on
,, 18. There were about 200 fresh laid eggs.
,, 28 to August 1st. A pair of Roseate Terns about the breeding grounds.

Aug. 7. Young Terns still hatching.

* Mr. Hamond's address is Twyford Hall, East Dereham, and he would be grateful for additional subscriptions.

Breydon Wild Birds Protection Society.—Mr. Henry P. Frederick, the Hon. Sec. is to be congratulated upon having sufficient funds to enable him to employ a watcher on Breydon during the whole of the close time, and the Society has done excellent work in securing the safety of many rare birds which visited that favourite resort during the summer of 1906 ; it is quite refreshing to read of the rare birds SEEN instead of SHOT, and as the watcher is a very experienced man, there is no doubt as to the accuracy of his identification of the various species. His Diary records Swallows seen on 17th April, Godwits first on 27th, and a Spoonbill on 28th of the same month. The Lesser Terns appeared on 6th May, Greenshanks on the 14th. On June 9th Wigeon were still on Breydon, on the 15th a Lesser Tern was feeding its young one, and on the 14th a Little Gull was seen. On July 21st a Pelican was seen which stayed till the next day, also a Spoonbill. On August 9th, a Little Gull was seen, and on the 15th a Spoonbill which stayed till the 19th. On the 21st two Stilt Plovers flew over Breydon in a westerly direction, and an immature Little Gull was seen. On and after May 7th to 17th, and again on 18th June, Black Terns were seen, but unfortunately none stayed to nest, but seeing that the whole area of the Broads is a " protected District," there is still hope that if perfectly undisturbed Mr. Hamond's anticipation may be realised and that like the Black-headed Gulls at " Mow Creek," they may once more return to their former nesting sites.

The above are some of the more important entries in the watcher's Diary, and it may be taken for granted that the safety of all these birds, so far as Breydon was concerned, was due to the presence of the Society's watcher.—T. S.

Corticium (Peniophora) Chrysanthemi, Plow.—For many years past I have been familiar with a Corticium appearing in Autumn on the bases of the stems of Chrysanthemum plants, both on the remnants of last year's stems and toward the end of the season on those of the current year. This

Corticium resembles to the naked eye the Corticium so common upon Elder (*C. sambuci*), looking for all the world like a splash of white-wash. The appearance of the fungus means the death of the plant sooner or later, generally within a year. The fungus itself is of a very rudimentary type, it being more like a patch of some mould rather than a Hymenomycete. The stroma is very loose and open in texture, it possesses no definite margin and takes its irregular surface from following the irregularities of the bark upon which it happens to grow. The cystidia are surmounted by a globular head about 3 μ across, and measure from 20 to 25 μ from base to apex. The basidia are flattened at the top, and bear two or more generally four pointed sterigmata. The spores are colourless, oval in form and have usually a large nucleus. They measure from 5 to 8 μ in length by 3 to 5 μ in width. The fungus is found principally upon the lower part of the stems, but it also often extends to surrounding earth which it mats together into masses that adhere to the stems when they are pulled up. The foliage of the plants attacked is thinner and more attenuated, while the new shoots they send up are shorter. It would be interesting if this pest were found to be as common round Norwich as it is in the gardens at King's Lynn.—C. B. Plowright.

Note on "Woad" (communicated by Mr. Arthur Bennett, F.L.S.).—"Willm. Hod of Boflet, Normandy, shipped to Portsmouth 10 hogsheads of Woad, which were immediately seized by others and carried off to Guildford, whither Hod followed in pursuit, regained possession and lodged it in the castle. Then Nicholas Picard and Willim the Vinter of Kingston and others from Normandy came and demanded the Woad for one Stephen Bukerel. On receiving a refusal they came on the morrow to execute a threat of burning the town accompanied by 200 men. Then Nicholas Sir John's clerk became alarmed and delivered up the property. Abbrev.: Rai. M.S. Hen. III. 1265.

J. G. Wallar, 68 Bolsover St., London, W.

MEMBRANIPORA MONOSTACHYS, var. FOSSARIA.—Mr. H. E. Hurrell reports having refound this Polyzoon in a salt-water ditch at Southtown, Great Yarmouth. It was originally recorded from this district by Hincks (Brit. Marine Polyzoa, 1880, p. 133). It has also been found in abundance in the salt marshes at Aldeburgh, by Dr. S. F. Harmer.—ED.

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CONTENTS.

	List of Officers	v
	List of Members	vi
	Statement of Accounts	x
	Catalogue of Additions to the Library	xi
	President's Address	329
I.	Norwich Castle Mound. By J. T. Hotblack, F.G.S.	338
II.	*Liparis læselii*, Rich. An Extension of Range. By A. Bennett, F.L.S.	340
III.	*Silene otites*, *Artemisia campestris*, and *Chenopodium botryodes* in East Anglia. By A. Bennett, F.L.S.	343
IV.	Southern Grey Shrike (*Lanius meridionalis*) in Norfolk. By J. H. Gurney, F.Z.S.	352
V.	*Helix pomatia*, L., at Grimston. By Henry Laver, F.S.A.	354
VI.	Observations on the Poisoned Spines of the Weever Fish, *Trachinus draco*. By H. Muir Evans, M.D., Lond.	355
VII.	The Poison Apparatus of the Weever. By J. O. Borley, M.A.	369
VIII.	Some Old-Time Norfolk Botanists. By Thomas Southwell, V.-P.	374
IX.	Notes on the Natural History of Thetford District. By W. G. Clarke	386
X.	The Distribution of Flint and Bronze Implements in Norfolk. By W. G. Clarke	393
XI.	The Crustacea of the East Norfolk Rivers. By Robert Gurney, B.A.	410
XII.	Meteorological Notes, 1906. By Arthur W. Preston, F.R. Met. Soc.	439
XIII.	Some Notes on the Coot, and Great Crested Grebe. By Miss E. L. Turner, F.L.S.	449
XIV.	Notes on the Yarmouth Herring Fishery, 1906. By T. J. Wigg	455
XV.	Some Additions to the Norwich Castle-Museum in 1906. By Frank Leney	458
XVI.	Natural History Notes from Yarmouth. By Arthur H. Patterson	460
XVII.	On the Early Stages in the Life Histories of Certain Fresh-Water Fishes. By Frank Balfour Browne, M.A. (Oxon.), F.R.S.E.	478
XVIII.	An Entomological Visit to Hunstanton. By Claude Morley, F.E.S., etc.	489
XIX.	Miscellaneous Notes and Observations	493

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1907—8.			
To Subscriptions:—			
1 „ 1902—03	0	5	0
1 „ 1903—04	0	5	0
1 „ 1904—05	0	5	0
6 „ 1905—06	1	10	0
24 „ 1906—07	6	0	0
183 „ 1907—08	54	18	0
9 „ 1908—09	2	14	0
	65	17	0
„ Additional payments for Notices	0	16	0
„ Sale of *Transactions*	2	4	8
„ Grant from Life Membership Fund	6	0	0
„ Interest on Life Membership Account	1	15	6
	£76	13	2

Cr.	£	s.	d.
1907—8.			
By Balance due to Treasurer March, 1907	5	6	6
„ Fletcher and Son, Printing *Transactions*	50	15	6
„ Ditto Stationery	0	7	0
„ Goose and Son, Printing, Stationery, and Postage ..	5	2	9
„ Postage (Hon. Sec.)	4	17	9
„ Ditto (Assistant Sec.)	0	17	0
„ Insurance	0	9	0
„ Year Book of Societies	0	6	0
„ Norfolk and Norwich Library, Use of Room	1	1	0
„ Gratuity to Museum Doorkeeper	1	0	0
„ Assistant Secretary's Salary	5	0	0
	75	2	6
„ Balance at Messrs. Barclay's	1	10	8
	£76	13	2

LIFE MEMBERSHIP FUND.

1907.	£	s.	d.
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„ 1 Additional Composition	1	0	0
„ Interest to Nov., 1907	1	15	6
	£73	15	6

1907.	£	s.	d.
By Transferred to Current Account	6	0	0
„ Ditto (Interest)	1	15	6
„ Balance in Norfolk and Norwich Savings Bank ..	66	0	0
	£73	15	6

Norwich 25th March, 1908.

Examined with vouchers and found correct,

FRANK C. HINDE, *Auditor.*

List of the Publications received by the Society as Donations or Exchanges from March, 1907.

ALGA FLORA of Yorkshire. By W. West, F.L.S., and G. S. West, B.A., A.R.C.S., Leeds, 1901.
Presented by Yorkshire Naturalists' Union.

BACILLARIAN, Beds in the Ocean Bottom, Finding of the. Pamphlet. By Arthur M. Edwards, M.D.
Presented by the Author.

BATH Natural History and Antiquarian Field Club, Proceedings of the. Vol xi. Part 2. 1907.

BELFAST Naturalists' Field Club. Annual Report and Proceedings. Series II. Vol. v. Part 6. 1906—07.

BIRDS, The International Convention for the Protection of, concluded in 1902, and Hungary. By Otto Herman. Budapest, 1907. *Presented by Mr. H. G. Barclay, F.R.G.S.*

BIRDS of Western Europe. 3 vols. By L. Olphe-Galliard, 1884—1892. *Presented by Mr. J. H. Gurney, F.Z.S*

BRISTOL Naturalists' Society, Proceedings of the. Fourth Series. Vol. i. Part 3. 1907.

BRITISH Association for the Advancement of Science, Report of 77th Meeting, Leicester, 1907.

——— Report of the Corresponding Societies Committee and of the Conference of Delegates, Leicester, 1907.

BRITISH MUSEUM (Natural History), Publications :—
General Guide 1906.
Guide to Mammals (other than Ungulates), in Dept. Zoology, 1906.
——— Reptilia and Amphibia Dept. Zoology, 1906.
——— Great Game Animals (Ungulata) do 1907.
——— Fossil Reptiles, Amphibians and Fishes in Dept. Geology, 1905.

British Museum (Natural History), Publications :—

——— Fossil Invertebrate Animals in Dept. Geology, 1907.

——— Exhibition of Old Natural History Books, 1905.

——— Books and Portraits illustrating History of Plant Classifications, in Dept. of Botany, 1906.

——— Memorials of Linnaeus, 1907.

List of British Seed—Plants, and Ferns, Dept. Botany, 1907. *Presented by the Trustees, British Museum.*

Botany. Reprints. Juncus Balticus Willd (from Ann. Scot. Nat. Hist.). Potamogeton Pensylvanicus in England, (from Naturalist). By A. Bennett, F.L.S. *Presented by the Author.*

Cambridge Philosophical Society, Proceedings of the. Vol. xiv. Parts 1, 2, 3, 4. 1906—07.

Cardiff Naturalists' Society, Transactions of the. Vols. xxxix, xl. 1906—1907.

Croydon Natural History and Scientific Society, Proceedings and Transactions of. February 13, 1906 to January 15, 1907.

Ealing Scientific and Microscopical Society, Report and Transactions for 1906—07.

Edinburgh, Proceedings of the Royal Society of. Session 1906—7. Nos. 1, 2, 3, 4, 5. Vol. xxvii. Nos. 1, 2, 3, 4, 5. Vol. xxviii. Edinburgh, 1907.

Edinburgh Geological Society. Vol. ix. Part 1. Edinburgh, 1907.

Entomology, Oriental. By Rev. F. A. Walker, D.D., F.L.S. Being a Paper read at a Meeting of the Victoria Institute, *n.d.* *Presented by Mr. James Hooper.*

Essex Naturalist, being the Journal of the Essex Field Club. Part 8. Vol. xiv. Parts 1, 2, 3. Vol. xv. 1907.

Flora of West Yorkshire. By Frederic Arnold Lees, M.R.C.S. London, 1888. *Presented by Yorkshire Naturalists' Union.*

Food of Fishes, (North Sea, 1904—05). Second Report on the. By R. A. Todd, B. Sc. Asst. Naturalist on the Staff. Reprinted from Internat. Investigations, Marine Biol. Assoc. London, 1907. *Presented by the Author.*

Fossil Flora of Tegelen-sur-Meuse, near Venloo, in the Prov. of Limburg. By Clement Reid, F.R.S., and Eleanor M. Reid, B. Sc., with 3 Plates. Amsterdam, 1907.

Presented by the Authors.

Fourmis et les Guêpes, Notes sur les. C. Janet. 1906.
Presented by Mr. J. H. Gurney, F.L.S., F.Z.S.

France, Bulletin de la Société des Sciences Naturelles de l'Ouest de la. Deuxième Serie. Tome vi. 3e and 4e. Trimestre, 1906. Tome vii. 1e and 2e Trimestre. Nantes.

Fungus Flora of Yorkshire By G. Massee, F.L.S., and C. Crossland. F.L.S. London, 1905.
Presented by Yorkshire Naturalists Union.

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ADDRESS.

Read by the President, SYDNEY H. LONG, M.D., *to the Members of the Norfolk and Norwich Naturalists' Society, at their Thirty-ninth Annual Meeting, held at the Norwich Castle-Museum, March 31st,* 1908.

LADIES AND GENTLEMEN—Notwithstanding the increased subscription—from five to six shillings—the number of members stands at 284, being slightly in excess of last year. Six members have resigned, five have died, and thirteen new members have been elected.

The Society has lost by death Professor Alfred Newton, F.R.S.; Mr. C. A. Wright, F.L.S., F.Z.S.; Mr. Charles Williams, F.R.C.S.E.; Sir James Hector, M.D., K.C.M.G., F.R.S., and Mr. Howard Saunders, F.L.S., F.Z.S.

Mr. T. Southwell has written "In Memoriam" notices of the late Professor Newton and Mr. Saunders, the former illustrated by an excellent portrait, copies of which have been presented to the Society by Mr. J. H. Gurney. These notices will appear separately in our 'Transactions.'

By the death of MR. CHARLES WILLIAMS, F.R.C.S.E., the Society has lost one of its original members. Born at Gloucester in 1829, Mr. Williams, after a distinguished career as a student, came to Norwich as House Surgeon to the Norfolk and Norwich Hospital—in 1858. After holding this appointment for a few years, he settled in Norwich, where he practised as a surgeon up to the time of his death, August 15th, 1907. Although never a contributor to the Society's 'Transactions,' Mr. Williams always took a great interest in its welfare.

Charles Augustus Wright, F.L.S., F.Z.S., &c., who died on July 15th, 1907, in his 74th year, from the effects of a terrible accident, had been a member of the Society for over twenty years. In early life he became the Special Mediterranean correspondent of the 'Times,' making his home at Malta, and during his residence there he made many cruises as the guest of his friends in the navy, visiting every part of the Mediterranean. During this period he devoted his time to working out the Fauna and Flora of his island home, taking special interest in its ornithology and conchology; nor did he neglect its Archæology as is proved by his election to the Vice-presidency of the local society. His most notable papers were those on the Birds of Malta, published in the 'Ibis' in 1863 and 1874.

On his return to England, he settled at Kew, where his house became a recognised meeting-place for his scientific friends, and his garden a delight to every one.

Nothing pleased him more than to be asked for information on some rare plant or bird; he would at once set to work to unravel its history, and often the amount of information he was able to communicate was astonishing. The Natural History Museum at Florence owes many specimens of Italian birds to his generosity, and in recognition of this and his Zoological work the order of Knight of the Crown of Italy was conferred upon him in 1883.

In addition to numerous transactions and proceedings of learned societies received by way of exchange, we have to thank the following members for donations of books, pamphlets, etc.—Mr. J. H. Gurney, Mr. H. B. Woodward, F.R.S., Mr. Eustace Gurney, Mr. Arthur Bennett, Mr. Clement Reid, F.R.S., Mr. Robert Gurney, Mr. R. A. Todd. Mr. C. Morley.

As it is usual for the President to give a short account of the work done during the year, I will now proceed to review it briefly. On 30th April, 1907, some "Notes on the Floscularia

of Great Yarmouth District," by Mr. H. E. Hurrell, were read, and Mr. Arthur Patterson exhibited a series of lantern slides of bird life taken by Dr. Heatherley, and also contributed some Notes of his own for February, March and April.

On 28th May, a letter was read from the Wild Birds' Protection Society to Mr. G. F. Buxton, pointing out that Goldfinches and Owls were not sufficiently protected in Norfolk, and a sub-committee was formed to enquire into the matter. The question was brought before the Norfolk County Council, and in consequence of this and the representations of other bodies, the necessary protection was obtained. At the same meeting Mr. J. T. Hotblack read a paper entitled, "With the British Association in South Africa."

On the 27th June, by the invitation of Mr. J. H. Gurney, an excursion of the members, in which about twenty-five took part, was made to Keswick Hall. After inspecting the duck-ponds, aviaries and various foreign birds and animals, all of which excited great interest, the party was entertained at tea at the Hall, and then conducted by Mr. Edward Knight through the grounds of the Old Hall. A very enjoyable afternoon was spent.

On the 18th July, the members were invited to How Hill, Ludham, by Mr. and Mrs. Boardman, and hospitably entertained. An interesting ramble through the grounds and marshes was taken: also a row on the picturesque Crome's Broad. Some rather uncommon plants were found, which provided material for discussion.

Unfortunately, our Delegate was unable to attend the Conference of Corresponding Societies of the British Association at Leicester, in August, so I will briefly allude to what took place at the Conference, obtaining my information from the printed Report.

The Chairman of the Conference, Mr. H. J. Mackinder, M.A., delivered an address on the Advancement of Geographical Science by Local Scientific Societies, and indicated special

lines of geographical research in which local societies might co-operate. He alluded to the work already accomplished by Mr. W. G. Smith on the "Geographical Distribution of Vegetation in Yorkshire," and by Mr. Robert Smith in his "Botanical Survey of Scotland," as typical of this kind. It was pointed out, however, that such work required to be done according to some more or less uniform scheme. The study of plant-associations necessitated, for its interpretation, a knowledge of the local land-forms, drainage systems, drift geology, climate, etc., and separate maps should be constructed dealing with all these orders of phenomena. On comparison of these maps, correlations of distribution will leap to notice, and will suggest fresh enquiries. In conclusion, the chairman said, that "while we can advance knowledge only by being specialists, yet we do require that in each important society there should be one or more whose speciality consists in the correlations for the locality of all the other specialities; and in my opinion these correlations can best be accomplished on a geographical basis and by geographical methods."

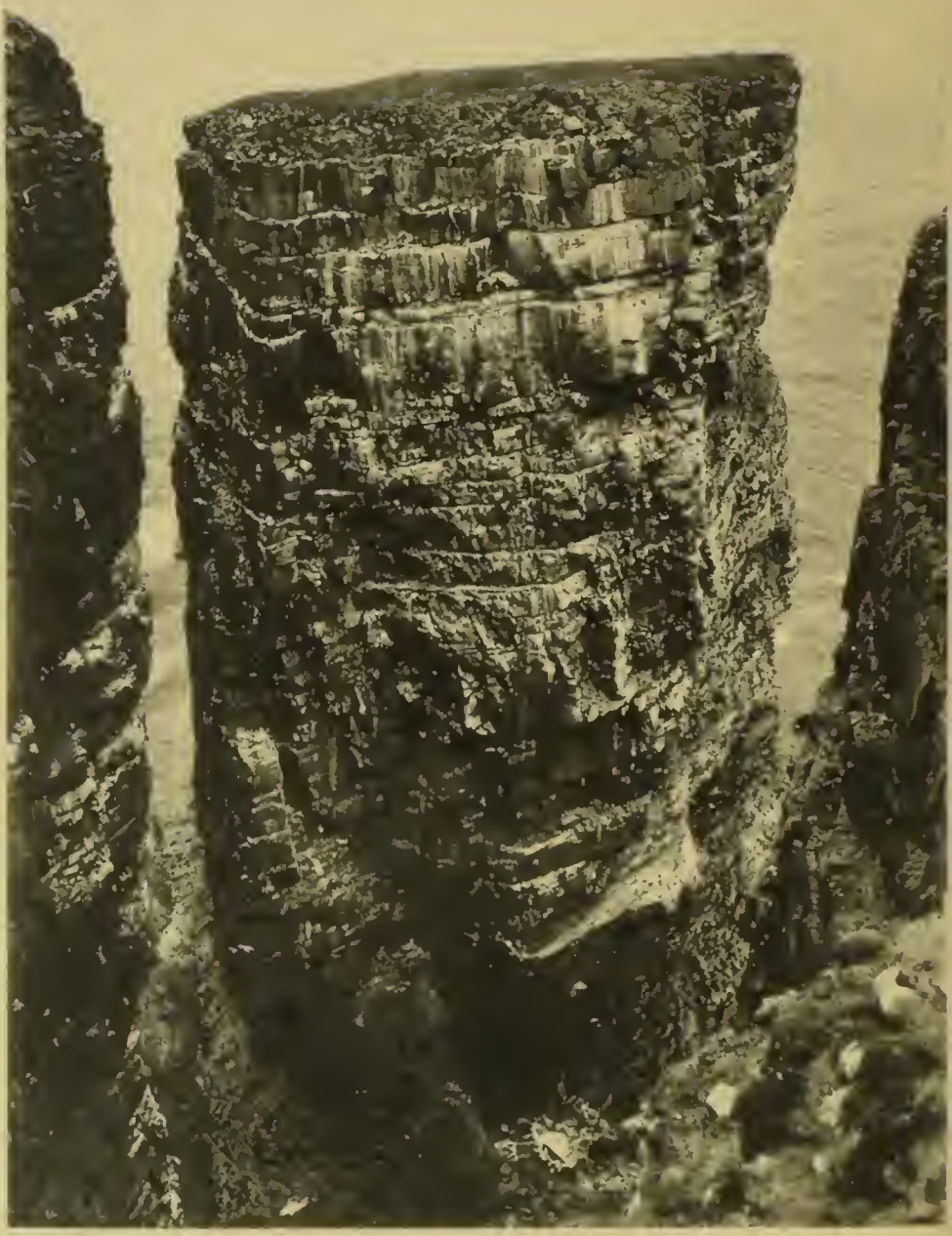
Other subjects discussed at the Conference were :—

The Photographic Survey of Ancient Remains in the British Islands, and suggestions for the encouragement of the study and investigation of the Fungi occurring in the districts of local societies.

On 24th September, Mr. F. Long sent for exhibition two specimens of the Wentle-trap Shell (*Scalaria communis*) from Wells; Mr. A. Patterson read some "Field Notes"; Mr. Eldred announced that he had received three Great Bustards which had been obtained from Spain by Mr. D. Scott Bayfield; and Mr. Thouless read a letter from Rev. A. Miles Moss, from Lima, containing remarks upon the Lepidoptera, vegetation, etc., of Peru.

On 29th October, Mr. T. Southwell read an "In Memoriam" notice of the life of the late Professor Alfred Newton, F.R.S., and Mr. F. Long a paper on the "Salt-marsh Flora of Wells."

BRITISH MUSEUM
NATURAL HISTORY



Mr. A. Bennett contributed a paper on the "Distribution of *Veronica verna*, L.; *V. triphyllos*, L.; *Herniaria glabra*, L.; and *Scleranthus perennis*, L."

On 26th November, your President exhibited a specimen of a hybrid Pheasant; Mr. A. Patterson read some "Notes"; the Rev. R. B. Caton sent some tables of observations on the arrivals of migratory birds at Great Fakenham, Suffolk, and Mr. Gerald H. Gurney gave an account of the Butterflies found at Digne, in the Basses Alpes, and exhibited many beautiful specimens.

On the 28th January, 1908, Mr. A. Patterson sent for exhibition a specimen of the Black Sea Bream, obtained off Cromer. The Hon. Secretary announced that Mr. Robert Gurney wished to collaborate with him in the preparation of a Botanical Survey of the Broads District, and asked for the co-operation of botanical members of the Society. Mr W. H. Burrell showed specimens, and read some notes on "*Leucobryum glaucum*, Schp." Dr. D. G. Thomson read a paper on the "Bringing up and taming of a Hare." Mr. C. A. Hamond remarked on the Luminous Owls of North Norfolk. Mr. W. G. Clarke read a paper on "Norfolk Neolithic Harpoon-barbs and Triangular Knives," and the Rev. E. N. Bloomfield contributed a list of "Additions to Norfolk Algæ."

On February 25th, Mr. W. G. Clarke read a paper entitled "Some Breckland Characteristics;" Mr. R. J. W. Purdy one on "The Occasional Luminosity of the White Owl."

Other papers contributed were "Meteorological Notes for 1907," by Mr. A. W. Preston, F.R. Met. Soc., and "Insects of the Breck," by Mr. Claude Morley, F.Z.S.

THE BIRDS OF HANDA.

THERE are few, if any, places in the British Isles that afford more attractions to a Naturalist for a Summer holiday than do the Highlands of Scotland, and to one whose principle hobby is Bird-watching, I would recommend the west coast of Sutherlandshire.

It was at the little crofter village of Scourie, about 20 miles south of Cape Wrath, and some 500 miles north of Norwich, that I spent a fortnight of my annual holiday in June last, and so full of interest did I find this district with the adjacent island of Handa, that I think perhaps a description of it will be of more interest to you to-night than an attempt on my part at original observations on any other subject, for which I have not at present sufficient workable data.

The journey from Norwich to Scourie must occupy two days, because the last 45 miles from Lairg, the nearest point on the Highland Railway, has to be covered in the mail motor-bus which leaves Lairg daily at 10 a.m. Lairg itself is a small town at the eastern end of Loch Shin, and is the centre from which coaches start for the villages and towns further north. It possesses a very comfortable hotel in the "Sutherland Arms" overlooking the lake, and here one must stay the night if intending to proceed to the West Coast.

The only item of ornithological interest that I have to note in connection with Lairg is the fact that there is a small colony of Black-headed Gulls breeding here. One of these birds had become very tame, and would take without fear at meal times any dainty morsels that were placed on the dining-room window-sill for him. On the adjacent moors I came across several pairs of Curlews with either eggs or young ones, and, near by, a few pairs of the Common Gull, the eggs of which I found.

On the morning of June 6th at 10 a.m., we, that is, my wife and I, started off in the motor for Scourie where we arrived at 4.30 in the afternoon. The road for the first twenty miles borders upon the northern side of Loch Shin, and the scenery over this part presents nothing very striking. We then begin to enter the famous Reay forest and get into one of the wildest and boldest parts of Sutherlandshire. At Stack, the shooting-lodge of the Duke of Westminster, the scenery is very fine, and here, so I was informed, a pair of Golden Eagles still have their eyrie. As we passed through, it was my

fortune to see one of these magnificent birds soaring above a precipice about a thousand feet high where, as likely as not, his nest was situated. When within about three miles of Scourie, one passes a loch which I will now mention on account of an interesting incident I witnessed upon it later. The loch in question is roughly about 400 yards across in each direction, and in the centre is a small island on which stand a few dwarf Birch trees about 15 feet high. As we passed, I noticed several Herons sitting on these trees, and I saw also that they had nests, so I mentally resolved that I would re-visit this loch, and especially keen was I to do so when I heard later that it was well stocked with Trout.

On June 12th, I paid my second visit and investigated the Heron Island. There were some ten or twelve nests, most of which one could see into from the ground. One nest only had eggs, and as the others all contained young birds in various stages of development, I concluded that the first clutch of this nest had been taken. On my looking over the edge of one nest, so scared were the young birds at my sudden appearance that they all fluttered and fell out—excepting one. This fellow took to flight, and with the aid of a fair breeze managed to get within about fifty yards of the shore, when he gracefully settled upon the water and swam the remaining distance, still assisted somewhat by the breeze. When he reached the bank he stood up and having taken his bearings in a most dignified manner, walked up to the heather and there hid himself behind a rock. Now, this bird had certainly never been out of his nest before, and yet when the unexpected necessity arose, he was able without any previous practice or schooling, not only to make use of his wings for purpose of locomotion through the air, but also to adapt his legs under the water to a process which even his parents had probably never attempted. I did not stay long on the loch after this incident, yet I have not a doubt that soon after I was gone, one of the fourteen old birds, who had been

standing like sentinels on the sky-line of the surrounding hills, came down and congratulated this young adventurer upon his fortunate escape.

To resume. On first seeing Scourie, one is impressed by the absence of all trees and by the bareness of the hills; but one soon learns to find in this a charm. Even at a later time of the year, when the Heather is in bloom, the effect can hardly be more impressive than that produced by the masses of flowering Gorse and Broom, far more vivid in colour than one ever sees in England, and falling in places on the banks of the lochs like a golden cascade down to the water's level. And how numerous these lochs are! Lochs of all sizes, from the huge Loch Shin some 16 miles in length, to the little tarn on the neighbouring hill-side. From the tops of the hills one can see them in every direction, and also the many inlets from the sea, scarcely to be distinguished from the lochs. Most of them are well stocked with Trout, and on twenty or so a boat has been placed—free fishing rights being extended to all who stay at the hotel.

To the ornithologist the chief attraction of Scourie is, of course, Handa, which is an island about one mile two furlongs in length by one mile in breadth, and distant about three miles from Scourie. Only on a fine day can the island be visited, as the trip across the intervening bay has to be made in an open boat, and at one place only on the island can a landing be effected, which if the sea be at all rough, becomes both difficult and dangerous. A very good description of the island has already been published by Mr. Harvie-Brown in his 'Fauna of the North-West Highlands and Skye,' so that I will merely say that it may be looked upon as a huge mass of rock that has been separated from the mainland on its eastern side. On its northern and western sides the face of the rock is a vertical cliff, about 300 feet in height, and intersected by a number of horizontal and parallel ledges. On its southern side it gradually inclines towards the sea-

BRITISH MUSEUM
NATURAL HISTORY

LANDING PLACE, HANDA.

level. For the most part it is covered with grass and heather, and sheep are fed upon it. At one place on the north side a large mass of rock has become separated by some 20–30 yards from the main island, and this is known as the Great Stack. The sea has washed its way into the base of this stack so that it now stands upon four pillars. The sheer sides of the Great Stack are also intersected by parallel ledges, and these alone provide accommodation for many thousands of birds.

When birds are seen in very large numbers it is extremely difficult to estimate, with any degree of accuracy, their numerical strength; but I think I may safely say that, during the breeding season, there are on Handa considerably over a million birds. On one section of ledge, some four yards long, I counted 70 Guillemots, and as there are about twenty of these ledges rising in superimposed tiers on a cliff line nearly two miles in extent, this will perhaps give a better idea of the number of birds, especially if it be borne in mind that they are often three and four deep on the ledges. One would think it impossible the birds should remember the site of their individual eggs, but this does not seem to be the case. As I lay on the cliffs I watched numbers of Guillemots returning from long distances on the sea, and they would invariably fly almost in a straight line for their eggs.

There is no systematic taking of eggs on Handa, as there is at some breeding-places, *e.g.*, at Flamborough Head; but at the same time, by employing a cragsman from Scourie, almost every variety of the Guillemot's and Razor-bill's eggs can be obtained.

I was much impressed with the care that these men take over their work. After going over the cliffs some hundreds of times, one might think they would become negligent of details. But that is not so. On one of my visits, Donald Morrison must have gone down at least twenty times for me, and he was just as careful to test the ropes, etc., on the last

occasion as on the first. It is tiring work, but I remember well on this occasion, whilst we were unroping him for the last time, we caught sight of a very unusually marked clutch of Kittiwake eggs in a nest low down and in a most unget-at-able position. He was quite eager to go down again to get these; but I'm glad to say we did not allow him to take the risk.

I have taken considerable pains to try and get as complete a list as possible of the birds that are known to nest on Handa, and in the compilation of this list I have had the advantage of the experience and shrewd observation of Donald Morrison, who for the past 27 years has been the Duke of Sutherland's keeper on this part of his estate. The birds enumerated below have, except when otherwise stated, quite recently nested on the island.

Corvus corax (Raven). This is a resident species. For the past twenty-seven years at least, so I am informed by Morrison, Ravens have bred on Handa. Now and again their young ones have been taken or killed, and whenever this has happened, the old birds would shift the next year to the mainland, only to return again the following year to their old haunts. A pair of Ravens nested on Handa in 1906, but not last year, and whether or not they have returned to the island this year is not yet known, as up to the present the weather has been too stormy for boats to land. Of the many species of birds that nest on Handa the Raven is the first to lay her eggs; they are usually found at the beginning of March.

Corvus cornix (Hooded or Grey Crow). Another resident species. A pair or two of these birds regularly breed on the island and, when I visited it last year, the site of a nest on the west side was pointed out to me.

Falco peregrinus (Peregrine Falcon). On the western side of the island there still remains the site of the nest of the White-tailed Sea Eagles which formerly bred here. But,

NATURAL HISTORY

July the birds begin to leave, and by the commencement of the shooting season (August 12) all the ledges on Handa are practically deserted.

ALCA TORDA (Razor-bill). Although numerically not so strong as the Common Guillemot, yet there are vast numbers of these birds that resort to the Handa Cliffs for breeding purposes. As in the case of the Guillemot, the single egg is laid on the bare ledge, and although there would seem to be some attempt on the part of the two species to keep separate, yet they are frequently found side by side on the same shelf.

FRATERCULA ARCTICA (Puffin). The Puffins on Handa are far less numerous than are the Guillemots and Razor-bills because the accommodation for their burrows is limited. They are found principally on the highest parts of the cliffs, and also at one place on the north side of the island, where there has been a cleft in the rock, at which part a certain amount of soil and debris has accumulated. The most formidable natural enemy that this bird has to contend with during the breeding season is the common Rat, and at one time these vermin became so numerous on the island, that an appreciable decrease in the number of Puffins was noticed. However, about twelve years ago the Rabbits on the island, of which there were many at that time, were ferreted, and since then the Rats have considerably diminished in numbers. Recently, I hear, Weasels have been introduced, so that before very long the Rats will probably disappear altogether.

PHALACROCORAX CARBO (Common Cormorant). There are a few ledges where this bird breeds, but the species is not nearly so numerous as it is on the adjacent (Badcall) islands.

PHALACROCORAX GRACULUS (Shag or Green Cormorant). Wherever there are suitable ledges and caves these birds are to be found nesting all round the Handa Cliffs.

LARUS ARGENTATUS (Herring Gull). A considerable number of this species of Gull nest on Handa. The nests are mostly found on the top of the island and on the slopes leading down

BRITISH MUSEUM
NATURAL HISTORY

SHAGS AND GUILLEMOTS ON HANDA.

to the cliffs. These daring egg-stealers are ever on the look-out for uncovered eggs on the ledges, and during the course of the season a large number must be taken by them and by their Black-backed cousins.

LARUS FUSCUS (Lesser Black-backed Gull). Only a very few of these birds nest on Handa, and although there is a large colony of *Larus marinus* on the Stack at the N. E. end of the island, the lesser Black-back is not allowed to share this impregnable position with them.

LARUS MARINUS (Great Black-backed Gull). In his 'Fauna of the North-West Highlands and Skye,' Mr. Harvie-Brown says of this species, "When I first remember Handa there were some twenty to twenty-five pairs of Great Black-backed Gulls upon the summit of the Great Stack (300 feet). But about the years 1873 and 1876 this sanctuary was, for the first time, invaded by two men and a boy from Uist, at the request of the late Mr. Evander McIver, because these birds were becoming destructive, and were increasing in numbers. They have never returned to nest upon the Great Stack. Indeed in 1903, as shown by photographs taken by Mr. Norrie at the 'height of the season,' there were no birds of any kind nesting on the flat top at any point visible from the land, though the ledges immediately below were densely crowded—the Guillemots especially actually jostling one another as the photographs also show." Last year there was one pair of Great Black-backs breeding on the top of this Stack, as I myself witnessed.

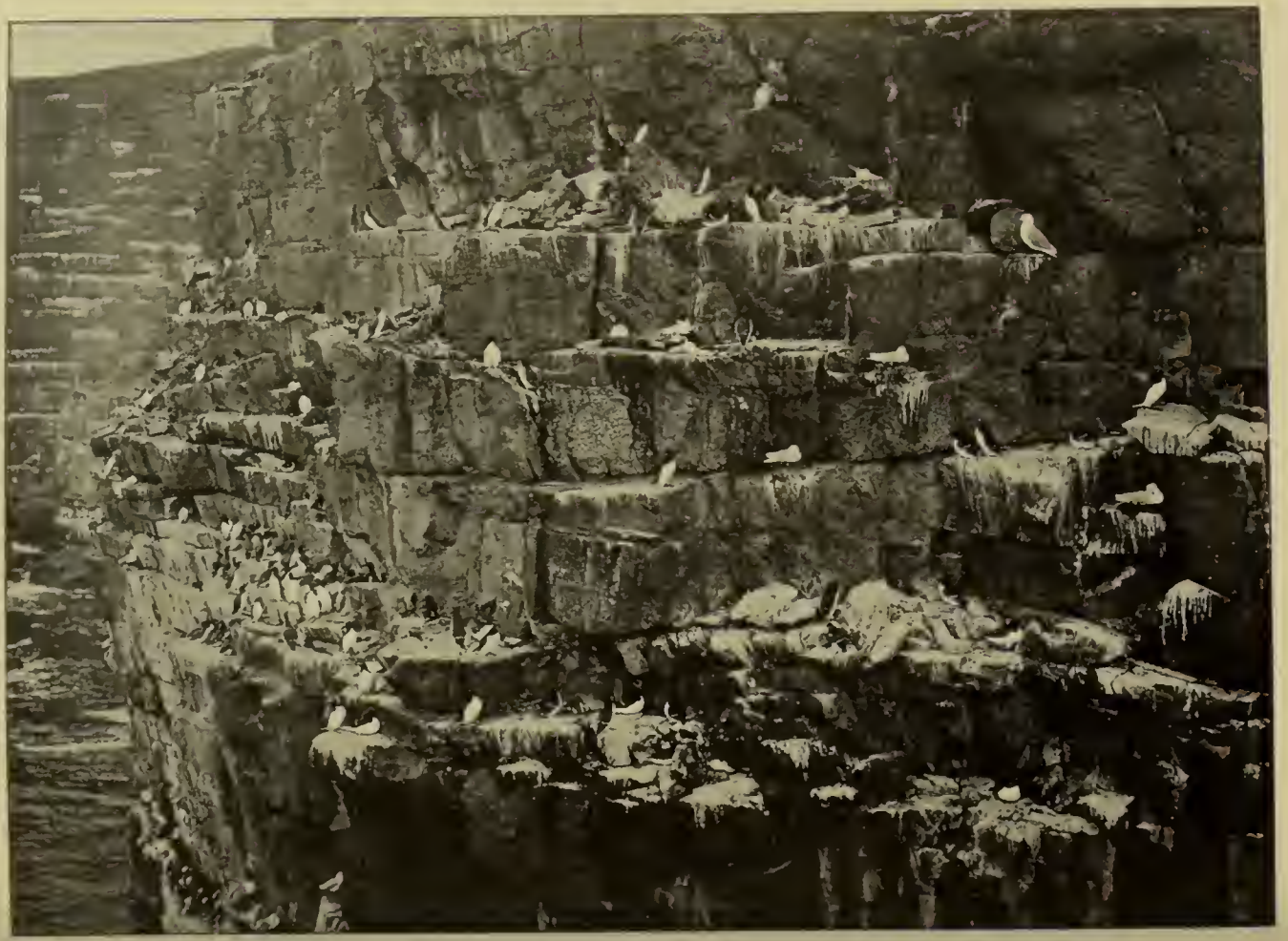
On the north-east side of Handa there is another Stack, about fifty to sixty yards from the main island, and on this, which is quite inaccessible to any human being, a large colony of Great Black-backed Gulls breed yearly.

Now of all the marauders that search the moors in the nesting season for the eggs and young of the Grouse, the chief is, undoubtedly, the Great Black-backed Gull, and during my stay at Scourie a gentleman from Buckinghamshire,

who has a shoot at Loch Inver, sailed up to Scourie in his yacht, with his keeper, for the express purpose of seeing how many of these egg-stealing culprits they could account for with their rifles. In a recent communication to me on the subject, he says : " Our campaign on the Black-backed Gulls on Handa was not a very great success ; we accounted at that time for about two dozen birds—half being Black-backs, the other half Herring Gulls. Later, I sent my keeper to kill the young toddler Black-backs on the Stack as they hatched out, and he estimates his kill at twenty or so. They hid in crevices and inequalities as soon as the firing began. Later. in August and September, I kept up a pretty constant offensive from a boat round Loch Inver, and got about 260 altogether. A few of these were Great Black-backed Gulls, more the Lesser Black-backed ; a good many were Herring Gulls, who are just as evilly disposed, and a large number were Gulls in immature plumage which were either Herring Gulls or Black-backs—quite a number, from their size, being the Greater Black-backs. My keeper writes, there are now (Feb. 15th, 1908) very few Black-backs to be seen anywhere, but of course it isn't the weather for boating, and unless you boat you won't see much any way."

Rissa tridactyla (Kittiwake), There is a very large colony of these birds on Handa during the breeding season, and much of the charm inseparable from the cliffs is, to my mind, due to the presence of these beautiful birds. Their graceful, slow-winged, sinuous flight shows up to great advantage as compared with the rapid-winged whirr of the Guillemots and Razor-bills, who take a bee line from the sea to their egg ; and after one has been watching for a time, this continuous flight of thousands of birds to and fro the cliffs, it is with a sense of some relief that one suddenly realises that it is only one's head that is hanging over the edge after all, and that the remainder of one's body is still resting securely on the top of the island.

BRITISH MUSEUM
NATURAL HISTORY



The nests of the Kittiwakes are often found in the immediate neighbourhood of the Guillemots and Razor-bills, but generally speaking they colonise together and select the more rugged places on the cliffs, and frequently at a lower level than the other two species.

Fulmaris glacialis (Fulmar). Mr. Harvie-Brown has exhaustively dealt with the subject of the first appearance of this bird on Handa for breeding purposes, and the earliest date for which he has positive information of the Fulmar nesting on the island is the year 1902, when there were about eight pairs. Since that time they have slightly increased in number, and last year (1907) there were about twenty pairs. The site they have chosen is the highest and most precipitous part of the cliff on the northern side of the island, about 300 feet above sea-level. Even to such experienced cragsmen as the brothers Matheson, and Donald Morrison of Scourie, most of the nests are quite out of reach, owing to the overhanging nature of the cliffs at this part. The long, straight pinioned wing of the Fulmar is a characteristic by which he may easily be identified, when in flight, from any other bird for which he is likely to be mistaken.

Somateria mollissima (Eider Duck). This is the only Duck that nests on Handa, but not in any number. The adjacent (Badcall) Islands are more frequented by this species than is Handa itself.

Hæmatopus ostralegus (Oyster-catcher). Although I did not myself find a nest of this species on Handa, yet there is no doubt that they regularly breed on the island. On a small rocky island, some few hundred yards from the main island of Handa, I found several pairs breeding, and on this same island I found a nest, containing four eggs, of the Eider Duck.

Colymbus septentrionalis (Red-throated Diver). For the last seven or eight years a pair of these birds have regularly nested on Handa, and I believe I have reliable information for stating that during this period they have

never been robbed of their eggs. The site of the nest is known to me.

Numenius arquata (Common Curlew). Not uncommon on the surrounding moors, and frequently found nesting on the island.

Gallinago cœlestis (Common Snipe). The latest record I have of a pair of Common Snipe nesting on Handa is the year 1894.

Charadrius pluvialis (Golden Plover). On the surrounding moors these birds are to be found nesting in several places, as I was able to verify by my own observations; so that it is not to be wondered at that they should occasionally resort to Handa for nesting purposes.

Vanellus vulgaris (Lapwing). The remarks under Golden Plover apply equally to this species.

Ægialitis hiaticola (Ringed Plover). During my several visits to the island I did not meet with this species, although it is a regular breeder there. In a recent communication from the Duchess of Bedford, she says, with reference to this bird, the Twite, Meadow-Pipit and Wren, "Always on the island during my visits in the months of May, June and September."

Alauda arvensis (Sky-lark).

Anthus pratensis (Meadow-Pipit).

Anthus obscurus (Rock-Pipit).

I myself met with all these three species on Handa in June last, and from the evidence I have received from several trustworthy Oologists I have no doubt that they nest on the island.

Saxicola œnanthe (Wheatear). I discovered the whereabouts of the nest of a pair of Wheatears on one of my visits to Handa last year, but failed to reach it. This species regularly breeds on the island.

Sturnus vulgaris (Starling). A regular breeder on the island.

Troglodytes parvulus (Wren).

Linota flavirostris (Twite).

Beyond the fact that these two species have been frequently seen on Handa during the breeding season, I have no further evidence that they nest on the island.

One cannot make mention of Handa without referring also to the Badcall Islands, a group of some twenty small islands about four miles to the south of Handa.

On a most perfect summer's day (June 14th), and with just sufficient breeze to allow us to sail comfortably, I made a visit to several of these islands. My primary object was to obtain eggs of the Black Guillemot, but in this I was not successful, though we saw many of this species swimming and diving about. As is well known, the Black Guillemot lays her couple of eggs in crevices or slits in the rock, and very often at a considerable distance, sometimes many feet, from the surface, so that before you can find the nest you must previously have seen one of the old birds come out of the crevice, and then you must devise some suitable apparatus for bringing up the eggs to the surface. The whole proceeding is by no means an easy one, especially if the face of the rock is slippery and inclining towards the sea—conditions which fortunately for the birds, but unfortunately for the collector —only too often prevail.

There are a few species of birds that nest on the Badcall Islands which do not nest on Handa.

Of these I will mention :—

Anser cinereus (Grey Lag-Goose).

Anas boscas (Mallard).

Mergus serrator (Red-breasted Merganser).

Uria grylle (Black Guillemot).

Larus canus (Common Gull).

Sterna macrura (Arctic Tern).

Procellaria pelagica (Storm-Petrel).

On one of the islands upon which we landed I espied through my glasses as we approached, a solitary old Gray Lag-Goose on the summit of a promontory, but by the time I had reached the top, a by-no-means-easy climb, he had gone, and I could find no trace of either his mate or young ones, though there was plenty of evidence that Geese had recently been on the island. Some of the Badcall Islands are heather-covered, whereas others have only grass growing on them; and, contrary perhaps to what one might have expected, these Geese, so I was assured, nest only on those islands where heather grows.

I found numbers of nests of the Common Gull, Lesser Black-backed and Herring Gulls, and on one of the smaller islands, composed of bare rock and but a very few feet above high-water mark, I came across several nests of the Oyster-catcher.

There were several Eider Ducks, mostly males, swimming about the islands, but I only found one nest, which contained six eggs. There is a small colony—100 pairs perhaps—of Arctic Terns that regularly breed on the Badcall Islands, but I do not think many eggs had been laid at the time of my visit.

It is strange that a bird like the Common Wren should select such remote places as these islands for nesting purposes, in preference to the main-land, but such is one of the many, as yet unexplained peculiarities of this interesting little bird. I only saw one Wren when I made my visit, but I was assured by the keeper that a goodly number of this species breed on these islands.

The photographs accompanying this paper were taken by Mr. W. Norrie, of Fraserburgh, to whom I wish to tender my thanks for permission to reproduce them.

MUSEUM
NATURAL HISTORY

Mayall Phot

Alfred Jeckyll

Born June 11. 1829 Died June 7. 1907.

I.

PROFESSOR ALFRED NEWTON, F.R.S.

AND MR. HOWARD SAUNDERS.

In Memoriam.

It is with sincere regret that we have to record the death of our valued Hon. Member, Professor Alfred Newton, F.R.S., which took place in Cambridge, on 7th July, 1907.

Professor Newton was born at Geneva in 1829, and was the son of William Newton of Elveden Hall, Suffolk, by Elizabeth, daughter of R. S. Milnes of Fryston, Yorkshire. His early youth was spent at Elveden, and he resided there until he entered Magdalene College, Cambridge, where he graduated in 1853; he secured the prize for English Essays in both 1852 and '53, and was appointed travelling fellow of his College, visiting N. America and the West Indies; he also travelled in Iceland and Lapland, and in 1864 with Sir Edward Birkbeck paid a visit to Spitzbergen. On many of his summer holidays he accompanied the late Henry Evans yachting to the West coast of Scotland, but an unfortunate accident many years ago, producing chronic lameness, greatly impeded active exercise, much to his regret; but the experience acquired in his foreign travel, during which the pursuit of his favourite study was always to the fore, stood him in good stead in after life.

In 1866 Newton was elected Professor of Zoology and Comparative Anatomy by his University, a chair which he held till his death, with great advantage to the study of zoology and distinction to himself. Of his many contributions to his favourite science of Ornithology it is not necessary to speak here, they are so well known and have already been enumerated in the memoirs which have appeared; but in

addition to the first two volumes of the 4th Edit. of Yarrell's British Birds which he edited, ornithologists throughout the world are deeply indebted to him for his masterly 'Dictionary of Birds,' a work the value of which cannot be overestimated, and the Introduction to which displays the depth and extent of his vast acquaintance with ornithological literature, and is a standing monument not only of his profound knowledge of his subject but of that precision and clearness of diction for which his writings are so remarkable. His last literary effort was the completion of the 'Otheca Wolleyana,' a monumental memorial to his deceased friend John Wolley, with whom he was associated in forming the wonderful collection of the eggs of the birds found in the western palaearctic region of which it is a catalogue. The preparation of this catalogue was the work of many years, the first part having been published in 1864, and the fourth, completing Vol. 2, not till the present year, 1907. It was always the professor's ardent hope that he might be spared to complete what he regarded as a tribute to the memory of the friend he valued so highly, and whose early death he constantly lamented, its accomplishment gave him unbounded satisfaction. Some idea of the extent of this great work and of the collection which it describes may be gained from the report of the Strickland Curator of the University Museum of Zoology (Dr. H. Gadow), when recording the presentation of the latter to the University.

Dr. Gadow, after referring to the noble use made by the Editor of "the bequest of his friend and fellow-traveller not only in working out the great collection . . . but by nearly doubling it, ... and thereby amassing a well-nigh perfect collection," proceeds to describe the catalogue, a work of about 1300 pages, which "contains 6076 separate entries, referring each to from one to more than a dozen eggs, in all perhaps 20,000 specimens. The work is, however, not a mere enumeration; it contains hundreds of critical remarks on the breeding habits of between 500 and 600 different species of birds . . . . and is illustrated with 36 plates, many of which represent characteristic Lapland scenery."

There were two other tasks which the Professor proposed to carry out, and for the performance of which he had collected an immense amount of material, but which his busy life did not permit of his accomplishing ; the one was an exhaustive history of the extinction of the Great Auk, or Gare-fowl as he preferred to call it, and the other a like history of the extinction of the Great Bustard in Britain. Of the former he gave us a foretaste in a paper in the 'Ibis' for 1861, entitled "An Abstract of Mr. J. Wolley's Researches in Iceland respecting the Gare-fowl or Great Auk," and a paper in the 'Natural History Review,' "The Gare-fowl and its Historians," in 1865 ; also a second paper in the 'Ibis' on "The Orcadian Home of the Gare-fowl" in 1898. In the 'Otheca Wolleyana' are figured the seven eggs of this extinct bird in the Wolley Collection, together with illustrations of thirteen others reproduced in plaster, and coloured in fac-simile by the late John Hancock. Of the extinction of the Great Bustard in Britain, a subject in which for many years he took the greatest interest, the raw material I believe exists in his "*Otidiana*," but although he generously gave great assistance to Mr. Stevenson and myself when writing the history of that species in the 'Birds of Norfolk,' I believe he published nothing but the history of the eggs of that species contained in the Wolley Collection as described in the 'Otheca.'

But his published works, numerous as they are and valuable, do not represent a tithe of his services to ornithology ; there are few modern books of any repute on the subject which are not directly or indirectly indebted to him, and many have been wholly inspired by, or are due to, his initiation. In recognition of his services to Zoology he was awarded a gold medal of the Royal Society, of which body he had served as a Vice-President, and in 1900 he was the recipient of the gold medal of the Linnean Society.

I have already mentioned the interest which Professor Newton took in tracing the extinction of the vanished fauna not only of the continent of Europe as evinced by his valuable paper on the "Zoology of Ancient Europe," but also of the islands of

the Pacific; he was not less keen on the protection of the species found in his native country, which were in danger of sharing the same fate; it was owing to his advocacy at the Norwich Meeting of the British Association in 1868, that practical steps were taken to secure legislation for the protection of Wild Birds, the result of which has proved so beneficial especially to the birds found in this county, and it was mainly to his practical advice that the Committee appointed by the British Association for the purpose of collecting statistics on the subject of migration, and of which he was long the Chairman, were enabled to get together the mass of statistics which Mr. Eagle Clarke has so ably summarised. Newton was also one of the founders of the British Ornithologists' Union, and took part is editing the 'Ibis,' the Journal of that Society, which has maintained a foremost place in Ornithological Literature to the present time.

With regard to Professor Newton's social qualities, a friendship of more than 50 years enables the writer to speak with confidence, but they cannot be better expressed than was done in an appreciative Obituary Notice which appeared in the 'Times' of the 8th June, 1907. "He was gifted," says the writer, "with an affectionate nature, which was not the less real because if found little verbal expression; and, possessed of old-fashioned courtesy of manner, he had the best characteristics of the race of English country gentlemen to which by birth he belonged. Staunch in his friendships, firm in his opinions, and following what he held to be right with dogged perseverance, he was a man of whom any one might be proud to be a friend." His somewhat severe aspect to strangers soon gave way to his peculiarly genial smile, and he spared no pains to be helpful to beginners; his valuable Zoological Library was always at the service of those engaged in research; he was always cheerful for he was always occupied, and his great panacea for all troubles was work—his correspondence alone must have occupied a large portion of his time, his replies to enquirers were so prompt and full. No application for advice or assistance was in vain, and even ordinary expressions of thanks were distasteful to him, all

was done for the sake of his beloved science. All loose or florid writing or any departure from the strict logic of fact was abhorrent to him, and of him it might truly be said, "No life can be dreary whose work is a delight." As to Professor Newton's helpfulness to beginners the writer before quoted, referring to his Sunday Evenings which had long been a Cambridge institution, says, "Undergraduates interested in science were welcomed by him, and to a large number of Cambridge men these pleasant evenings must form one of the happiest memories of their student days. But Professor Newton's evenings did more than give pleasure; his kindly encouragement was educational in a better sense than often falls to that unpleasant word, and was of real service in keeping alive a love of Natural History in Cambridge." He considered it part of the duty attaching to his University appointment, as well as the pleasure it afforded him, to exert himself to the utmost to encourage the study of Zoology.

Professor Newton was elected an honorary member of our Society in 1869, and Vice-President in 1901, and has repeatedly shown his interest in our welfare; in 1870 he contributed his first paper to our 'Transactions,' "On a Method of Registering Natural History Observations." This paper was the result of a series of observations taken at Elveden, extending over a period of ten years, by himself and his brother Edward (the latter in after years a President of our Society). It is a standing monument to the care and energy for which its compilers were so distinguished, the recorder being only 21 years of age when it was commenced. It would occupy too much space to describe the method adopted in this register for which I must refer you to the original papers, but the results of an analysis of the records were as surprising as they were interesting at the time, enabling the observers to announce that the Song Thrush was "one of the most regular migrants among birds, ... a fact which had been neglected by almost every English historian of the species." Equally interesting facts with regard to the economy of the Robin were revealed. In 1876 Professor Newton contributed an interesting paper "On the Naturalisation of the Edible Frog in Norfolk"

(vol. ii. p. 254). In 1879 some remarks "On Hawking near Yarmouth" (vol. iii. p. 34). In 1885 a "Memoir of John Scales" (vol. iv. p. 81). In 1893 a paper "On the Great Flood of 1852-3 in South-West Norfolk" (vol. v. p. 560). In 1896 a paper on an "Early Notice of Spoonbill Breeding in Norfolk" (vol. vi. p. 158). In 1899 a note on "The Mention of a Bustard in Norfolk in 1675," and "On Some Cranes' Bones found in Norfolk" (vol. vii. pp. 113 and 158). In addition to these papers, Mrs. Richard Lubbock communicated through Professor Newton some interesting letters relating to the Natural History of Norfolk (vol. ii. p. 388), to which the latter contributed valuable notes as well as to the White-Marsham correspondence published in the Second Volume of our 'Transactions' p. 133. Those of us who partook of Professor Newton's hospitality on the occasion of the Society's visit to Cambridge at his invitation on 22nd May, 1893, will have a lively recollection of his kindly reception and of the entertainments he provided for us.

The excellent portrait accompanying this memoir is the gift of Mr. J. H. Gurney, by kind permission of the editor of 'British Birds.'

Second only to the loss which ornithology, and incidentally our own Society, has sustained in the death of Professor Newton, is that of Mr. Howard Saunders, who died in London in October, 1907. Mr. Saunders was elected a member of the Norfolk and Norwich Naturalists' Society in 1883, and contributed a paper on the "Ornithology of Spain" to our 'Transactions' in August, 1872. Although this was his only contribution, he always displayed an active interest in the Society, and repeatedly expressed his satisfaction at the work which it has accomplished. To the public generally, Saunders will be best known as the Editor of the last two volumes of Yarrell's 'British Birds.' in succession to Professor Newton, and his 'Manual' on the same subject is a model of condensed information, but his contributions to ornithology were numerous and valuable. He possessed a world-wide reputation as the acknowledged authority on

the family of the *Laridæ*, and equally so on the Birds of Spain. His extensive travels in Europe and South America enabled him to speak with authority also on the distribution of birds, not only in the Palæarctic region, but over a much wider range; and his services as an active member of the Zoological, Linnean, and Royal Geographical Societies, and of the Ornithological Unions of both England and America, were numerous and valuable.

As a friend, his experience was always at the command of his fellow workers, and two such blanks as are created in the same year by Professor Newton and Howard Saunders will be severely felt by a large circle of friends and admirers.—

T. S.

II.

THE SALT-MARSH FLORA OF WELLS.

By Frederick Long, L.R.C.P.

Read 29th October, 1907.

The following notes are based on observations at Wells and the district with which I have been intimately acquainted for many years. Probably they will apply more or less to other districts.

Salt-marsh plants spend a life of their own, in their own wild way, severed from their congeners on the dry land by the line of limit of tidal water. In contrast with the surrounding land, the salt-marsh possesses a weird charm of its own. At first acquaintance it is apt to be regarded with horror and perhaps even with disgust. The dead-looking, scrubby vast level with its contained mud-flats and creeks, does not lend

itself sympathetically to the ordinary observer; but let him wait a time and he will probably come to a different conclusion when he has discovered the secrets it has to unfold.

I don't think the praises of the salt-marsh have been sung by any poet, but it came very near it once. Some years ago the late Lord Tennyson, when Mr. Tennyson, came to stay with a friend at Warham, and when his friend took him to some high land and showed him an extensive view of salt-marsh and sea, he threw up his arms in rapture. Had he acquired more intimate acquaintance with its varying conditions of atmospheric effects, its flora and bird life, the salt-marsh might have been immortalized in verse.

Standing on the quay at Wells and looking over the marsh, you see on the horizon, short of the sand hills, an indistinct rough ridge running east and west. This is the remains of an old bank that more than a hundred years ago shut out the tide from the marsh beyond, but now allows it to go through at three or four openings. Between this bank and the sand hills lies a somewhat triangular piece of marsh of 260 acres in extent, called the Lodge Marsh, of which 150 acres were under cultivation up to about the middle of the 18th century. It is chiefly about here that the extensive fields of *Statice limonium* and *S. reticulata* flourish in such profusion, and I know of no other such extensive tracts along the coast. Excepting the statice beds, the rest of the marsh is covered with *Suæda fruticosa*, and as you get nearer to the sand hills the ground becomes more sandy.

Till within the last few years there was a shallow channel admitting tidal water from the coast at high springs, which joined that coming from the main channel and creeks. This has now been closed by an artificial bank, so that a good part of the marsh about here is much drier now than it used to be, and sand is tending to collect on the level. Till recently rabbits abounded here and ate up every bit of grass and anything that was agreeable to their palate; even henbane, which was rather plentiful here at one time, did not escape their ravages. I am glad to say that they let the Statices quite alone, although I rather fancy they ate the young stems

of *S. reticulata*. Since the destruction of the rabbits and the closing of the channel, a change has been gradually taking place in the condition of the flora. Last summer I found two grasses that I had not seen before. These I sent to Mr. Arthur Bennett, who said one was *Poa subcærulea*, Smith, an addition to the county list. Of the other he said, "I do not remember to have seen this before, and I believe it to be *Festuca distans*, *L. p. capillaris*, Litj. — *Glyceria distans*, Vahl., var. *pulvinata*, Fries." He also quotes the following description of it from Anderssen in his Scandinavian grasses. "*Pumila* (dense *cæspitosa*) *culmis stolonibusque divergentibus* in *pulvino densissimo compacta*, *panicula depanperata*, *contracta*, *ramis abbreviatis imis subgeminis*, *glumis* (*paleisque*) *acutioribus*, p. 54, 1852." It grows in dense masses completely covering the ground, and one would think it might be a useful grass for growing on sandy wastes. The leaves are narrow, $\frac{1}{12}$ in., and from 12 to 20 in. in length. On account of the drier condition of this part, *Chenopodium rubrum* and var. *Pseudo-botryoides* and *Salicornia procumbens* all of which delight in a sandy mud-flat, occasionally covered by tidal water, have quite disappeared and their places have been taken by *Statice reticulata* which has of late spread over a considerable area where a few years ago not a plant was to be seen.

In treating of salt-marsh plants, I think they may be divided into two groups: (1) Those that grow on mud-flats and the sides of creeks, and like repeated doses of salt water, such as *Salicornia herbacea* and *radicans*, *Suæda maritima*, *Aster tripolium*, *Glyceria maritima*, *Armeria maritima*, *Spergularia media*, *Plantago maritima*, and a few others. (2) Those that grow on ground that is only covered at high spring tides, and consequently only get occasional doses of salt water, such as *Suæda fruticosa*, *Statice limonium*, *Statice auriculæfolia*, *S. reticulata*, *Frankenia lævis*, *Salsola kali*, *Artemisia maritima*, and others.

In making this division I only state it with reference to type forms each of which has its own horizon, although the species may be scattered about at different levels. Take,

for instance, *Statice limonium*, although this grows all over the marsh it is only on the parts that are less often covered by the tide and even where the tide never reaches to such as the higher slopes and tops of banks, that you find the largest plants, and the var. *pyramidalis*. In a correspondence I had with Mr. C. E. Salmon of Reigate, on the *Statices*, he was somewhat surprised when I said that the larger forms of *S. limonium*, and var. *pyramidalis* grew on rather drier parts, and quoted from Syme, E. B., "I have observed that when the Salt-marsh was drier than usual, the panicle had a tendency to revert to the common form." Of course I can't dispute Syme's observations, but on such an extensive area of Salt-marsh as at Wells, where there is no variation in the condition, there is no difficulty in seeing where the larger plants grow. They like their roots in the salt mud, but they do not care for repeated bathing of tidal water. So with *Statice reticulata* of which the finest plants, those of 12 to 20 in. diameter, grow on rolling sand covered knolls two or three feet above the highest spring tide. *S. auriculæfolia* always grows on dry sandy mud above high-water mark, and if some plants grow at a lower level and get washed by the tide, they are only three or four inches high. Taking the marsh altogether, it had been for many years a puzzle to me as to what was the cause of the great difference in the size and height of the plants of *Statice limonium*—that the plants should vary as much as from 2 to 18 in. In many places you will come across plants not more than two to four in. in height. I sent some of these to Mr. Salmon, who was much interested in them as he had never seen any less than four inches. From what I have noticed of late, I think it is simply a question of the amount of salt they get, and that the height of the plants varies inversely as this condition obtains. I can trace no other cause for it.

Some years ago I first noticed a grass growing on the marsh which I thought was *Festuca duriuscula*, although it seemed strange to find this grass in the same situations, and mixed with it, as *Glyceria maritima*. I sent it to Mr. Geldart and to Mr. Arthur Bennett, who sent some of it to Prof. Häckel,

and he named it as under: *Festuca rubra*, var. *duriuscula*. sub. var. *Grandiflora*, f. *littoralis*.

Spartina stricta grows in one place on the marsh, but is never more than eight or ten inches in height, and the greater quantity is much less, whereas on the south coast it is, I believe, about two feet. This difference may be due either to latitude or the greater or lesser quantity of tidal water they each receive.

What is the origin of salt-marsh plants it is difficult to say. Probably they were originally dry land plants, as most of them will grow in any garden soil if transplanted, although they won't migrate of themselves. Last autumn I put in my garden two plants of *Aster tripolium* and they are now 4 ft. and 4½ ft. high respectively, and have a profusion of bloom from top to bottom. These plants, however, did not come direct from the marsh, but from a fresh water dyke at Yarmouth, the sides of which are thickly fringed with plants from two to four feet in height, and with a profusion of bloom. The dyke is near the toll-gate on the Acle road. The water is very dirty from being near some allotments and piggeries, and this no doubt contributes to their luxuriance. How long the plants have grown there I can't say, but from long alienation from the salt-water, they have established themselves as much finer plants than their forbears of the marsh. I reared a number of seedlings which grew into equally fine plants, but of course they may fall back after a time, especially in a dry season.

III.

DISTRIBUTION OF *VERONICA VERNA*, L., *V. TRIPHYLLOS*, L., *HERNIARIA GLABRA*, L., AND *SCLERANTHUS PERENNIS*, L.

By Arthur Bennett, F.L.S.

Read 29th October, 1907.

Of these four species the first only is confined to E. Anglia, the second and the fourth are each found in one county only outside, the *Herniaria* though less confined is strictly a Germanic species in Britain.* All the Guernsey and Cornish specimens so named he has seen, Dr. B. Syme refers to *H. ciliata*, Bab. Until late years the two first were supposed to be confined to the "Breck" lands of W. Suffolk and W. Norfolk, but they have been gathered in E. Suffolk, the older records of such were considered to have been errors, but they have been confirmed by later observers.

The following account is a resumé of what is known of their distribution in England.

Veronica verna, Linn. Sp. Pl., ed. 1, 14, 1753.

Vernal Speedwell. Eng. Botany, t. 25. August 1. 1791. First record.

"Found by Sir J. Cullum near Bury in Suffolk." Rose's Elements of Botany, 445, 1775. Dr. Hind in his B. of Suffolk gives '1771,' but I do not know on what his authority rests.

* Though *H. glabra* is a reputed Cornish species it is doubtful. See Davey, Tentative List of Cornish Plants, 181, 1902.

Suffolk E. 25. 1866.

Lowestoft. W. W. Newbould in Syme's Eng. Bot., vi., 155, 1866.

Cookley. Rev. W. R. Tate.

Thorpe. Hele. Fl. Suff. 262, 1889.

Suffolk W. 26. 1775.

On a grassy sandy bank between West Stow and Icklingham. Sir J. Cullum, 1773. Brit. Mus.! In the Rye at W. Stow and Icklingham. Sir J. G. Cullum. Bot. Guide, 537. 1805. In the Rye at Wortwell. Sir J. G. Cullum in Gillingwater's Hist. of Bury. 1804.

Sandy field near Bury. 1846. Ibbotson sp. Near Bury and about Culford and Lackford. Sir J. Cullum in Dill. Ray in Hort. Oxon.

Dry heath between Mildenhall and Eriswell and in a Fir wood towards the Holywell road in great quantity. Babington, 1, 6, 1837. H. G. Glasspoole, 1886. 1 mile from Thetford on the Bury road (nr. Barnham Cross?), 1801, abundant. Crowe in Herb. Mus. Brit! Thetford. W. W. Reeves, sp. 1885. Thetford Heath. 5 inches high. 1879. A. Bennett. Brandon. Henslow and Skepper. Fl. Suff., 1860.

Cavenham and Lakenheath. Herb. Skepper and Lady Blake. Mildenhall, Boner, 1835; Glasspoole, 1886. Icklingham Heath and Elveden. 1877. A. Bennett. Near Barton Mills, Borrer herb! Icklingham Plains, 1876. Jordan sp. Barnham to Thetford. E. Forster, 1822! Herb. Mus. Brit.

Norfolk E. 27. 1805. Extinct?

Balking Hill. Harleston; Rev. H. Tilney in Bot. Guide. 420. 1805. "The features of the locality are now altered through cultivation and enclosure." Galpin. Fl. Harleston, 91. 1888.

Norfolk W. 28. Circa 1780. Crowe.

Foulden. J. Crowe. Santon Warren. abundant. 1880. A. Bennett. Heath to the S. of Thetford. E. F. Linton. Trans. Norfolk & Norwich Nat. Soc. vol. iii. p. 563. 1883. Croxton. 1888–9. H. D. Geldart ex Miss Geldart.

Reported from Sussex. Bot. Gaz., 307, 1849.

Denbigh. Faunila Grustensis, 1830.

Near London. Cooper. Fl. Metrop., 1836.

Surrey. Salmon. J. Bot., 221, 1903.

Distribution :—

Scandinavia, Spain, France, Belgium, Holland, Germany, Switzerland, Italy, Austria, W. Asia, India, Siberia, Turcomania.

V. TRIPHYLLOS, Linn. Sp. Pl. ed. 1, 14, 1753.

V. FLOSCULIS SINGULARIBUS, FOLIIS LACINIATUS ERECTA. Ray. Syn., 280, 1696.

Eng. name.

UPRIGHT CHICKWEED.

BLUNT-FINGERED SPEEDWELL. Smith Eng. Fl., 1, 95, 1828.

TRIFID SPEEDWELL. Syme, Eng. Bot. vi., 153, 1866.

FINGERED ,, Hind. Fl. Suff., 262, 1889,

First record. "*Alsine foliis hederacea Rutae nudo divisis Lob.*" Sent me by Thos. Willisel and found by him at Rowton in Norfolk and at Mewell in Suffolk." Ray. Cat. 340, 1670. Eng. Bot. t. 26, August, 1791.

SUFFOLK E. 1805.

Aldeburgh, the enclosures next the marshes at the entrance of the Town. Rev. Crabbe, Bot. Guide, 537, 1805.

Snape, Hele, Shottisham, Holmes. Hind. Fl. Suff. *l.c.* Bungay, Sir J. E. Smith. Suckling in Fl. Harleston, 1888. Barham Heath. Rev. W. Kirby, Bot. Guide, 1805.

SUFFOLK W. 26. 1724.

Barton Mills. T. Willisel. Dill, Ray. Syn. and T. Martyn.

Near Culford and Lackford. Sir J. Cullum. Dill, Ray. in Hort. Oxon.

Livermore. Rev. J. Dalton in York Phil. Soc. Herb. Icklingham sand fields. Sir J. Cullum, 5, 5, 1775. Jordan, 1876, sp. Thetford, 1846. B. D. Wardale. Brandon, W. J. Cross. Mildenhall, Browne in Bot. Guide, 1837.

Tuddenham herb. Wilson ; Elveden and Euston, E. F. Linton ; Barnham Church, Babington ; Little Thurlow, Herb. French. Cavenham D. Ward sp. 1887. W. Stow, Herb. Lady Blake ; Thetford and Lakenheath, Herb. Skepper.

Thetford Heath among Furze, *Cerastia* and short grass. 1877. A. Bennett.

Norfolk E. 27. 1670.

"Rowton (Roughton ?) between the town and the highway, 12 miles before you come to Norwich." T. Willisel. Ray. Cat. 1670.

Norfolk W. 28. 1670.

"Mewell, 'Suffolk,' between the 2 windmills and the Warren Lodge. T. Willisel" *l.c.* The name Methwold is pronounced Mewell, or Muell—hence Willisel's Mewell.

Many Norfolk names would hardly be understood by strangers, for instance, the Devil's post near Stalham. 'Hasboro,' few would suppose this meant Happisburgh.

Fields at Barton Bendish adjoining Swaffham Heath. D. Turner. Bot. Guide, 419. 1805.

Cockley-Cley. Woodward. *l.c.*

"Mill Hill, Wimbotsham and several sandy fields near and at Stow." Miss Bell. New. Bot. Guide. 1835. Snettisham. Trimmer. Fl. Norf., 1866.

Great Wretham. Herb. Mus. Brit! In the fields of N. Pickenham sparingly. Crowe in Hudson's Fl. c. 1780.

Thetford, Norf. Wardale, 1845. Thetford and Croxton. H. D. Geldart, 1888. ex Miss Geldart.

York S. W. 63.

Cornfields near Rossington. Toxfield. Hudson. 1778. About Cantley and Arnthorpe; G. E. Smith. Near Thorne; C. Gray.

York M. W. 64.

Sandy bank near Nether Poppleton. H. Wetherill. 1842. R. Moisen sp., 1877.

Hobmoor: S. Thompson. Lees. Fl. W. York. 1888.

Reported from near London. Kent and Warwick.

Distribution:—

Scandinavia. Spain. France. Belgium. Holland. Germany. Switzerland, Italy. Austria. Russia. W. Asia, India, W. Siberia. Turcomania. Algeria.

Herniaria glabra. Linn. Sp. Pl. ed. 1. 218. 1753.

Bald Rupture-wort, Gray. Nat. An. B. Pl. 547, 1821.

Burst-wort. Dr. Prior. Pop. names Br. Pl. 33, 1870.

Glabrous R.-wort, Syme. Eng. Bot. ed. 3.

First record.

"*Herniaria* . . . . in barren and sandy grounds," Gerarde. The Herball, &c., 453, 1597.

But the first specific record with locality seems to be Hudson's Middlesex one.

Middlesex. 21. 1760, last, 1795.*

Finchly Common, 1795. Dickson in herb. Babington. In meadows at Colney Hatch. Hudson Fl. Aug., 94, 1760. "We found it in a field at Finchly, and also at Colney Hatch." Milne and Gordon. Indig. Bot. 1, 455, 1793. I possess a sp. localised from "Harefield, Midd. Coll. G. Browner, 1875," but I can find no record of the station.

Suffolk W. 26. 1804.

On fallows near Barrow Bottom. Sir J. G. Cullum. Gillingwater's Hist. of Bury, 1804. W. West, Jun., sp. 1895.

Heath between Bury and Newmarket, about 5 miles from Bury on the right hand. Rev. G. Crabbe, Bot. Guide, 1805. Near the 8th milestone between Bury and Newmarket from Bury. Rev. R. Relhan, *l.c.* Has been found at Henham, Davy, *l.c.*, perhaps meaning Denham.

Tuddenham. Blomfield. Watson Sp. Bot. ed. 1, 626, 1874.

Cavenham and Risby Heaths. Jordan sp. 1875–8. Great Barton; roadside near Higham Station. Henslow and Skepper, Fl. Suff., 1860.

Higham Green in several places. Skepper M.S. Gedge sp. in Herb. Mus. Brit! Fallow N. of Risby chalk bank, 1895. W. West sp.

Kentford Heath, 1903. A. Wallis in herb. C. E. Salmon.

Norfolk W. 28. 1805.

Caldecote near Swaffham Heath. Rev. R. Forby. Bot. Guide, 426, 1805.

Narborough. Wardle, sp. 1846.

Fincham. Miss Bolton in her copy of With.; Fl. Norf.,

* Trimen and Dyer. Fl. Midd. 114, 1869.

1866. Beachamwell. Stock. Bot. Guide, *l.c.*, Swaffham and northwards. B. Bray, M. S. to Miss Geldart.

CAMBRIDGE. 29. 1855. Last in 1898.

Newmarket. Rev. Hemsted. Smith's Brit. Fl. 1, 1800. Near an enclosure ½ mile south of Six Mile Bottom Station. W. W. Newbould in Fl. Camb., 50, 1860.

LINCOLN S. 53. 1805.

On a heath near Sleaford on the road to Grantham. Rev. G. Crabbe. Bot. Guide, 386, 1805. Wilsford. R. Latham sp. in Herb. Mus. Brit., 1834! Ancaster, 1892. H. Fisher. J. of Bot., 22, 1894. About Quarrington, Wilsford, and Ancaster. Woodruffe-Peacock in Nat. 182, 1896. 315, 1895.

Ireland. Kerry in herb. Watson, but not noticed in the Cy. Hibernina ed. 2. 1898, or in Praeger's Irish Top. Bot., 1901.

Distribution :—

Jersey! Guernsey? Alderney, Portugal, Spain, France, Belgium, Holland, Denmark, Norway, Sweden, Germany, Switzerland, Italy, Austria, Russia, Algiers, N. and W. Asia.

Reported from many countries.

SCLERANTHUS PERENNIS, Linn. Sp. Pl. ed. 1, 406, 1753. S. ANNUUS var. PERENNIS, With. Arr. Brit. Pl., 506, 1830. Eng. name. PERENNIAL KNAWEL.

.. KNAPWEED. Hind. Fl. Suff., 1889.

SPREADING KNAVEL. Petiver, H. Brit. t. 9. t. 7.

First record. *Polygonum Germanicum incanum flore majore* about Elden in Suffolk, plentifully. Ray. Cat. ed. 2. 239, 1677.

Eng. Bot. t. 352, Oct. 1, 1796. W. Matthews, Esq., A new plate was drawn for Syme's 3 ed.

SUFFOLK W. 26. 1677.

Elden plentifully. Elden. Crowe Dill. Ray. in Hort. Oxon. 1768.

Between Elden and Thetford. A Bennett. Culford. W. Stow, and Icklingham Heaths. Sir J. G. Cullum in Hist. Bury, *l.c.* Icklingham, Skepper herb.. 1863. Babington. J. of Life, 201, 1897. Among the grass on a heath between Barnham and Thetford. E. Forster, Jun.. Bot. Guide, 1805.

Hind c., 1889. Lackford. Sir J. G. Cullum. Barnham, Elden, Eriswell, and Wangford. Hind, *l.c.*

Among grass, &c., in a heath near Lakenheath windmill. 1876. A. Bennett. Mildenhall near, Townsend in 'Phytologist' 2, 582, 1846.

Dry heath, Mildenhall to Eriswell, 1837. Babington, J. of Life, 62. Near Rednech Farm, *l.c.*, 1848. A Bennett, 1878.

Among short grass between Wether Heath and Icklingham, and on Icklingham Plains. A. Bennett, 1876.

Radnor. 1852.

"Specimens sent to Mr. Bennett, Dec., 1850." Purchas in Watson's Cyl. Brit. iii. 392, 1852.

Stanner Ricks. Babington Man. Br. Bot. ed. 6, 125, 1856.

Rev. W. Moyle Rogers sp. 1898.

Reported from many countries but the biennial form of *S. annuus* mistaken for it.

Distribution :—

All Europe, except Lapland and Finmark.

IV.

ARRIVAL OF MIGRATORY BIRDS AT GREAT FAKENHAM, SUFFOLK.

Observed by Rev. R. B. Caton.

Read 26th November, 1907.

	1887	1888	1889	1890	1891	1892	1893	1894	1895	1896	1897	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907
ALLOW - -	Ap. 18	Ap. 15	Ap. 24	Ap. 15	Ap. 18	Ap. 22	Ap. 13	Ap. 12	Ap. 13	Ap. 16	Ap. 3	Ap. 11	Ap. 18	Ap. 18	Ap. 19	Ap. 9	Ap. 7	Ap 13	Ap. 10	Ap. 16	Ap. 13
RYNECK - -	Ap. 18	Ap. 14	Ap. 22	Ap. 20	Ap. 25	Ap. 8	Ap. 9	Ap. 2	Ap. 13	Ap. 10	Mr. 31	Ap. 7	Ap. 12	Ap. 8	Ap. 9	Ap. 10	Ap. 12	Ap. 12	Ap. 11	Ap. 6	Ap. 27
ND MARTIN - -	Ap. 20	Ap. 22	Ap. 25	Ap. 18	Ap. 19	Ap. 11	Ap. 13	—	Ap. 13	Ap. 17	Ap. 12	Ap. 22	Ap. 13	Ap. 20	Ap. 14	Ap. 7	Ap. 12	Ap 13	Ap. 21	—	Ap. 24
DSTART - -	Ap. 21	Ap. 20	Ap. 19	Ap. 25	Ap. 22	Ap. 12	Ap. 17	—	—	Ap. 22	Ap. 24	Ap. 11	Ap. 19	Ap. 26	Ap. 22	Ap 25	My. 17	My. 1	My. 8	My. 18	—
LLOW WARBLER -	Ap. 22	—	—	—	—	Ap. 11	Ap. 10	—	—	Ap. 21	—	Ap. 16	Ap. 16	Ap. 20	Ap. 8	Ap. 7	—	Ap. 18	Ap. 13	—	Ap. 14
HINCHAT - -	Ap. 21	—	My. 6	My. 4	—	—	—	—	—	—	Ap. 8	—	Ap. 6	Ap. 11	My. 1	Ap. 21	Mr. 25	—	Ap. 29	—	Ap. 22
GHTINGALE - -	Ap. 24	Ap. 29	Ap. 22	Ap. 27	Ap. 23	Ap. 11	Ap. 16	Ap. 9	Ap. 12	Ap. 22	Ap. 11	Ap. 17	Ap. 12	Ap. 18	Ap. 10	Ap. 14	Ap. 27	Ap. 16	Ap. 13	Ap. 27	—
CKOO - -	Ap. 25	Ap. 28	Ap. 27	Ap. 24	Ap. 26	Ap. 25	Ap. 20	Ap. 9	Ap. 17	Ap. 19	Ap. 24	Ap. 16	Ap. 21	Ap. 25	Ap. 21	Ap. 18	Ap. 27	Ap. 24	Ap. 16	Ap. 30	Ap. 25
LLOW WAGTAIL -	Ap. 27	Ap. 16	Ap. 26	Ap. 20	Ap. 22	Ap. 12	Ap. 20	Ap. 15	Ap. 17	Ap. 21	Ap. 15	Ap. 9	Ap. 12	Ap. 21	Ap. 17	Ap. 10	Ap 20	Ap. 16	Ap. 14	My. 7	Ap. 15
IFT - - -	My. 5	My. 12	My. 12	My. 10	My. 22	—	My. 2	My. 6	—	My. 9	—	My. 6	My. 10	My. 5	My. 6	My. 6	My. 6	My. 13	My. 12	—	My. 12
OUSE MARTIN -	My. 4	Ap. 30	My. 3	Ap. 30	Ap. 28	—	Ap. 26	—	Ap. 23	—	Ap. 5	Ap. 26	Ap. 19	Ap. 29	Ap. 19	Ap. 14	Ap. 24	Ap. 26	Ap. 11	My. 2	Ap. 18
ACKCAP - -	My. 7	My. 5	—	Ap. 19	My. 5	Ap. 22	Ap. 28	—	Ap. 27	—	—	Ap. 26	Ap. 15	—	Ap. 23	Ap. 15	My. 5	My. 3	My. 8	My. 12	Ap. 19
MMON WHITETHROAT	My. 7	Ap. 26	Ap. 29	—	Ap. 30	—	Ap. 28	—	Ap. 20	Ap. 25	Ap. 15	Ap. 18	My. 9	My. 3	Ap. 23	Ap. 24	My. 2	Ap. 14	Ap. 14	My. 5	—
RTLE DOVE - -	My. 16	My. 9	My. 18	My. 2	My. 4	—	Ap. 24	—	Ap. 20	My. 8	—	My. 7	My. 3	My. 2	Ap. 27	My. 11	My. 14	My. 6	My. 2	My. 12	—
HEATEAR - -	—	Ap. 7	Mr. 30	—	Mr. 18	—	Mr. 17	Mr. 19	—	Mr. 23	Mr. 16	Mr. 28	Mr. 28	Mr. 13	Ap. 1	Mr. 24	Mr. 21	Mr. 14	Mr. 20	Mr. 10	Mr. 21
IFFCHAFF - -	—	Ap. 29	Ap. 16	Ap. 16	Ap. 20	Ap. 9	Mr. 27	Ap. 5	Ap. 19	Ap. 15	Mr. 23	Ap. 21	Ap. 18	—	Ap. 1	Ap. 8	Mr. 25	Ap. 15	Mr. 16	Ap. 2	Ap. 3
OTTED FLYCATCHER	—	—	—	—	My. 9	—	My. 6	My. 9	—	My. 13	—	My. 6	My. 14	My. 10	My. 16	—	--	My. 14	My. 27	—	My. 27
DBACKED SHRIKE -	—	—	My. 16	—	My. 15	—	—	—	--	—	—	--	My. 20	My. 10	—	My. 17	—	My. 23	My. 16	My. 29	—
DGE WARBLER -	—	—	—	—	--	Ap. 30	—	—	—	Ap. 26	Ap. 18	Ap. 27	Ap. 30	My. 6	Ap. 21	Ap. 25	—	Ap. 17	Ap. 15	—	—
RFOLK PLOVER -	—	—	—	—	—	—	—	—	--	—	—	—	—	Feb.16	Jan. 15	—	—	—	—	Fb. 22	—
NGED PLOVER -	—	—	—	—	—	—	—	—	--	—	--	—	—	Mr. 2	—	—	—	—	—	Fb. 26	—
ELDFARE - -	—	—	--	—	—	—	—	—	—	—	—	--	—	—	Oct. 29	—	Oct. 15	Nv. 12	Oct. 26	Oct. 26	Oct. 26

2. Was from home after 2nd May. Very cold March, fine April; birds earlier than usual. Corncrake very uncommon here, occurred 6th May, 1894, only occasion heard.

3. Earliest record of Swifts.

4. From home for a fortnight in April. Earliest record of Wryneck, Nightingale, and Cuckoo.

5. From home after 27th April. Earliest record of Turtle Dove.

6. From home after 24th April. The dates of Swallow and House Martin records here.

8. Very few Migratory Birds this year.

0. Very bad year, especially for House Martins. Attribute this to high W. winds, 10th, 11th, 12th, 13th, 14th, 15th, 16th April. The Norfolk Plover on 16th February was seen after a gale; very few Cuckoos, good many Nightingales.

1. Occurrence of 3 Norfolk Plovers in January. Curious, heard these birds off and on till the end of January. More House Martins than last year.

2. An absolutely disastrous year for Migrants. Thousands of Swifts and Swallows died in May; found four of the former dead round the Church, 22nd May. Very few Redstarts. Earliest record of Sand Martin and Willow Warbler.

1903. Another disastrous year for Spring Migrants, Redstarts very scarce. House Martins fairly numerous, had young birds as late as 19th October.

1904. Mild Spring, a good nesting season. Very few Redstarts, House Martins very numerous. Swifts late in arrival, stayed till 28th August, about a week or so later than usual.

1905. Very few Nightingales, Sand Martins; Flycatchers very late, Hardly any Redstarts. Swifts left between 19th and 27th August, very numerous; Sand Martins left 1st September. Earliest record of Chiffchaff, not common here.

1906. Absence from home in April made observations incomplete. Great many Cuckoos, Nightingales scarce. Swifts left between 19th and 26th August. Crows later than usual in arriving. Earliest record of Wheatear.

1907. Absent from home part of May. House Martins late in arrival, few had more than one brood; very few Shrikes. Redstarts are a rare bird though once lairly plentiful. Many Cuckoos. Fair number of Nightingales. Sand Martins left 20th August, they and Flycatchers were late in arrival.

BRITISH MUSEUM
NATURAL HISTORY

V.

NOTE ON A FORM OF *LEUCOBRYUM GLAUCUM*, SCHP.

By W. H. Burrell, F.L.S.

Read 28th January, 1908.

In the second edition of Dixon and Jameson's 'Handbook of British Mosses,' reference is made to a curious state of this plant collected by Miss C. M. Gibbings at Hedsor, Bucks, in "spheroidal balls or cushions, entirely unattached, consisting of stems radiating outwards from a central point and showing no lack of vigorous growth in spite of freedom from anything like attachment, which obviously must have lasted for a considerable period."

While walking through the woods at Aylmerton in the spring of 1907, I observed a considerable quantity of *Leucobryum* showing a similar development, and it seems desirable not only to report a county station for this interesting departure from normal habit, but to venture an opinion as to the cause.

The site is the slope of a hill under beech trees, where a considerable quantity of the moss occurs, showing intermediate stages between ordinary plano-convex cushions attached to the forest soil, and perfect unattached buttons with little or no distinction between upper and lower surfaces. The relation of some of the tufts to the substratum was instructive. In one case a tuft of almost perfect shape was adhering by radicles to a leaf of the previous year: its attachment to a recently fallen leaf and the cleanliness of the under surface, which was barely distinguishable from the upper surface, assisted in forming an opinion as to its history. In another case a tuft was resting on a mat of *Mnium hornum*;

it had been there long enough to be washed free from earthy matter and for its base to conform to the inequalities of the underlying moss, but obviously it had not originated there, for the *Mnium* was only slightly discoloured.

There are, I believe, three contributory causes.

(1) Special cell structure enabling the plant to retain moisture.

(2) The formation of vegetative buds from rhizoids on the leaves.

(3) Repeated accidental disturbance.

The latter is the predisposing cause, but the radiate growth which follows is dependent upon the two first named details in the plant economy.

With comparatively few exceptions the leaves of mosses are formed of a thin lamina consisting of a single layer of cells, with or without a nerve, the large surface exposed accounting for the rapidity with which these plants shrivel in dry atmosphere and reabsorb moisture from damp air. In *Leucobryum* there is a great development of the nerve at the expense of lamina, which is reduced to a few rows of cells at the leaf margins. A transverse section shows a central layer of small chlorophyllose cells embedded in two to four layers of large empty hyaline cells whose communicating walls are porous ; when dry these hyaline cells are filled with air and obscure the colour of the green central layer, hence the name *Leuco bryum*, white moss ; after rain the air is displaced by water, which can be squeezed out as from a sponge, and the green colour of the chlorophyllose cells becomes clearly visible. The leaves retain moisture for a long time, and maintain their vitality under conditions which would arrest growth in plants with one layered leaves. Braithwaite refers to the tendency of the plant to mature its capsules even in the drying press and recommends dipping in boiling water to prevent dehiscence.

Leucobryum rarely fruits ; reproduction is effected in general by buds rather than by spore formation ; reddish brown tomentum forms on the surface of the leaves, and from this rise buds which develop into new plants. This

habit of bud development combined with the power of retaining moisture under conditions which would place most mosses in a state of rest, is, I believe, a simple and sufficient explanation of the phenomenon.

In looking round for a cause for such frequent disturbance as would reverse the tufts from time to time and enable the buds to develop in all directions, the tread of sportsmen and woodmen and other human agencies seemed insufficient, and I was led to consider game birds as a possible medium, by the fact that I have long been familiar with the sight of small tufts of other mosses lying about open heathland. For example, in dry exposed situations *Dicranum scoparium* forms large low mats which are often strewn with small tufts which I have assumed have been pulled out by pheasants in search of food ; the activity of these birds may be gauged by examining a chestnut grove in winter ; torn and empty husks proclaim that the nuts have been consumed on the spot. It is worthy of note that the site at Aylmerton is under beech trees, whose fallen nuts would provide the necessary attraction. In large game may be found, I believe, an ever active and ever present source of disturbance ; scrapping for food they turn over the displaced tufts ; buds develop geotropically at whichever surface happens to be uppermost, giving rise to spheroidal cushions.

VI.

NOTES ON A TAME HARE.

By Dr. D. G. Thomson.

Read 28th January, 1908.

It is with some diffidence I bring these few notes before this learned Society, for I am alive to the fact that they are more desultory and casual than scientific, however, I believe even such notes on the nature and habits of animals are acceptable to the members as well as more purely scientific contributions to our 'Transactions.' Most of us are acquainted with the Hare from a zoological and from the sportsman's point of view, but beyond Cowper's well-known notes on his tame Hares, I have found but few details in our natural history books on this interesting animal. It is in the hope of adding a little to our knowledge of details, that I trespass on your time this evening.

Cowper, you may remember, had three Hares, all males. The first, which he got at three months old was, in spite of this age, easily tamed; the second always remained wild, he does not give the age he acquired it; and the third, although the most pugnacious and courageous of the three, was always tame, this last one died from the effects of damp bedding, he says, when full grown. The first lived nine years and died, he thinks, from some injury to the loins by a fall, and the second lived twelve years and died from gradual old age weakness. The poor old poet found in the periodic attacks of melancholy to which he was subject some gentle amusement and solace in the care of these animals by watching their frolicsome gambols and amusing ways, and his observations and short account of them are borne out in many particulars by my own observations.

I am glad to say it was for no such reason I. or rather my wife, undertook the upbringing and taming of our Hare. but it arose from the fact that on August 17. 1904. two Leverets were brought to us from a potato field. They were considered to be three or four days old ; they each had a star on the forehead, said to be a sign that they came from a litter of three ; this is unusual, for unlike the Rabbit. one is the usual litter. The Leveret eventually reared had a cut on the right shoulder.

Considerable ingenuity and patience was required to feed them, they would not lap or suck from a saucer, but seemed to get some sustenance from sucking a pledget of lint soaked in sweetened cows' milk. The mouth seemed proportionately extremely small, it was impossible to get anything in at the front of the mouth, the teeth overlapping and fitting so closely so that everything had to be inserted at the side. Smearing the fur with milk was tried. but the only satisfactory way was by a toy feeding bottle. The very sharp teeth. however. bit through the rubber teat at once. and this could only be prevented by covering it with muslin. chamois leather could not be kept sweet ; the Leverets were extremely dainty and particular as to the bottle and the sweetened milk. and as much and more care had to be taken as to cleanliness. temperature. any smell about the hands of the feeder. etc.. as for any human baby. About this time one of the two escaped, all I will say about him was that he was always much the wilder and more difficult of the two to feed. and I will confine my remarks to the one eventually reared.

The first week it was fed every three hours. the second week every four hours. and subsequently twice a day. it being pretty well known that Hares leave their young all day hidden up while they go about foraging. It was a very pretty sight to see him take his bottle. which it always supported in his front paws. If the milk had been boiled or was the least turned nothing would induce him to touch it. When five weeks old he weighed 1½ lbs. He was a most charming little creature. compact. firm. yet soft to the touch, with his varying shades of brown fur. his black tipped ears

and tail, his pure white waistcoat, and free from all objectionable odour; if he had any smell at all it was faint, fresh, and pleasant.

He slept in a basket in the bathroom, and then in a hutch in the garden, with a two-yard long run in it. As he grew older it was evident that he was dull and somnolent by day and disinclined for food, whereas towards evening he became lively and active and keen on his bottle. He came readily when the word bottle or milk was mentioned, and would jump up into my wife's lap of his own accord, while the long haired terrier dog of whom he never evinced any fear would sit by with grave decorum. Green food was gradually given; he ate grass, but it did not agree with him and was passed unchanged; he liked parsley and carnation leaves but, unlike Cowper's Hares and unlike Rabbits, did not like Lettuce. Every evening he was brought in a basket from his hutch into the house, and outer doors being shut, he ran about the various rooms and stairs at will.

This was, perhaps, from our point of view, the most interesting and amusing part of his career and we were never tired of watching his tricks and gambols. He would run up and down stairs with extraordinary rapidity either alone or with his friend "Max" the dog aforesaid. When first put into any particular room, the first thing he did was to thoroughly explore its boundaries and often to take six to nine feet jumps up against dead walls, till we expected him to injure himself in his falls; then he seemed to explore and examine the different pieces of furniture or other objects in the room with great curiosity, and always carefully examined anything new or in a new position.

The drawing-room, a long comparatively empty room, of some 35 feet, was his favourite Hippodrome, and there he brought off his grand Steeplechases, racing up and down like mad, turning and doubling almost quicker than the eye could follow, and jumping furniture or other obstructions placed in his way. If ever a young man rejoiced in his strength he rejoiced in his activity, and seemed to revel in it. It was curious to see how suddenly he could stop and his

breathing be quite slow and calm, for no rushing about seemed to make him breathless.

His chef-d'œuvres in the way of antics was to jump about a yard in the air, revolve right round, and with a sort of corkscrew movement plump right down in the usual crouching position. He often uttered a peculiar noise especially when in this young stage, a sort of cough, grunt and squeak with an exultant note in it, only making this sound when he was in quick movement. His slow movements were not at all graceful, the unequal length of his legs producing an inelegant hobble. With regard to his affection for individuals in the house, he had no liking for me, probably the smell of cigarettes about my hands or other characteristics was not to his tastes, although he was much the same to my boy who had no tobacco scent about him. If he did come to us at all, and he certainly came to my boy more than to me, it was to drum on, and at, us with his fore paws and give little sharp bites with his lancet teeth. He could drum with his fore paws with force and rapidity, and his sharp claws made it painful at times, and he seemed to like to beat a tattoo on any tambourine or similar surface presented to him.

He treated my little daughter much the same, and was very fond of drumming at her short skirts while standing on his hind legs, he would also bite and scrab her hair but never her face.

Whether because my wife fed him or not, I cannot say, but his affection for her was remarkable. He would come invariably at her call, and when she was sitting reading or writing would bound from quite a distance into her lap, and lie there quite snug and happy, on one occasion for two hours; he would lick her hands with a tongue not nearly so rough as a cat's but rougher than that of a dog. He wouldn't allow any handling of his ears or of his whiskers; he would, while still young, roll over on his back and show his lovely white waistcoat, and even lie on his back in my wife's arms, but as he got older he would not tolerate that position. He once tobogganed downstairs sitting on the skirt of her dress, bumping down each step unconcernedly; this, I think,

was, considering his nature, the most remarkable thing he did. He could not bear oil cloth or other smooth surfaces, as they afforded him no natural foothold. He seemed to like singing and piano music, and would jump to my wife's shoulder and lie about her neck while she sang.

In the early summer, 1905, he was half grown and used to have the run of the garden, a long fine string was attached to his neck, more to trace him when he got lost to sight in the bushes than to prevent his running away. We could not, however, trust him not to wander or run away, so one of us was always present; there he would scamper about, let us chase him, and he would repeat his drawing-room antics; he would let my boy and girl play with him, especially if their mother was there, and would sit in a toy cart while they dragged it about the lawn. He never, however, lost his alertness to danger, and was always truly *Lepus timidus*; the least unusual noise, and I suppose scents, made him listen with mobile ears or crouch down to make himself as invisible as possible. He showed no fear of our other dogs although not brought up with them as he was with the house dog. I cannot say that the first March we had him that he seemed to suffer from the proverbial madness, indeed the first year he was always in a state of crazy activity; when two or three years old, his general bearing was more sedate, and then he certainly was more lively in the spring, or at least the contrast was more apparent.

He was very fond of stretching himself and yawning in a standing position; he was scrupulously clean in his person, always washing his face with his front paws, he was very particular in licking his feet and toes and spread the latter out like a fan when doing so. He could not be trained like a cat or dog to be clean about the house, and I noted that the water passed was of an opaque white colour resembling milk (*Chyluria*).

In the early autumn of 1905 he was a year old and weighed $7\frac{3}{4}$ lbs. At this time my children left home for school, and my wife contracted a long illness, so the arrangements for the hare had to be altered. A big grass run was made for him

about forty yards by twenty, enclosed by wire netting around and above, and in the centre was placed his old hutch, and here he went on pretty much as before, except that his youthful frivolity gradually left him, and he would only run and jump as formerly when chased about by one of us, this he much enjoyed. He now ceased to have any milk, and was fed on oats and chopped carrots and apple parings and such green herbs as were brought to him; he would scarcely touch unchopped carrots or a whole apple, but was very fond of bread and loaf sugar given him as titbits when we visited his run, and he always came when called for these. He was generally found lying on the same hollowed out "form" and was by no means apparent at first, but he had other lies. He was perfectly delighted with the first fall of snow he knew, rushing about and half burying himself in it. The next spring he was decidedly wilder and tried to pull the wire fencing down, disordered his hutch and pulled the straw all about. He never touched water as water, except once when he sucked up a teacupful of some water colours painting water which was being used, perhaps some taste or scent in it appealed to him. Chickens and wild Ducklings were put at times in his run and he would feed quietly among them, but he was certainly jealous of them.

A big Belgian Buck Rabbit was once put in his run. He came up to it after a time and sniffed at it as he did everything strange, and then sprang on its back and began pulling out its fur, and the Rabbit had for its own sake to be removed. This is remarkable, as it is said that a Rabbit comes off best in a fight with a Hare. He absolutely took no notice of little Rabbits, but hustled a little Hare put in his run: he took friendly notice of Rabbits in adjacent runs, he never killed any stray Rats which came into his run and stole his food. He moulted towards autumn, and his winter coat was decidedly thicker and had many long white hairs in it.

He was taken occasionally into the house when fully grown, but he was not very lively or interesting, although he still scrabbed sofa cushions vigorously and showed his old liking for lying in my wife's lap, especially we thought, when she had

any silk about her dress. Why I have called the Hare "he" throughout this short paper I know not, because the sex was undoubtedly feminine, but no external sign of rut or œstrum was ever observed, although looked for. No opportunity occurred of obtaining a male consort, so no attempt at breeding in captivity could be made.

Unfortunately when three and a half years old the Hare died of some preventible disease of a dysenteric character, she had only been ill one or two days at most; as before mentioned, she never lay in her hutch, but the straw bed was always made up as she occasionally went in for shelter, and she was found dead in the morning lying quite under the straw bedding, showing like savages and most animals, an attempt to hide herself before death.

In spite of the great pleasure of watching the early life and inimitable activity and agility, with all the wonderful gambols and friskings, of a Hare, I cannot altogether recommend them as pets, because they are extremely difficult to rear and need infinite patience and care in feeding, then after the first year of life they become much quieter and less active, thus losing much of their main interest; and, lastly, because even if so much as a quarter acre enclosure be at their disposal, the confinement is unnatural for such a roaming and high speed animal.

I may suitably conclude these few notes by quoting Cowper's epitaph on one of his hares:

"Here lies whom hound did ne'er pursue
Nor swifter greyhound follow,
Whose foot ne'er tainted morning dew
Nor ear heard huntsman's halloo."

VII.

THE OCCASIONAL LUMINOSITY OF THE WHITE OWL (*STRIX FLAMMEA*).

By R. J. W. Purdy.

Read 25th February, 1908.

This subject is engaging the attention of many residents in North Norfolk where, as I shall hope to show, undoubted testimony exists to prove that there are two birds—almost certainly Owls—in this district which exhibit this hitherto unrecorded phenomenon.

From the desire, which I hope is shared by every genuine naturalist, to preserve the life of any creature whose habits are still under investigation, and especially of one which is known to conduce so greatly to the benefit of the agriculturist, I have hitherto, for obvious reasons, carefully abstained from giving my own name, or the locality, in which the observations now to be recorded have been made. Owing to this reticence on my part, insinuations have been made that the whole thing is a practical joke; I therefore think the time has arrived for me to make a full statement of the facts, with the names of those persons who have seen the birds in question. I feel persuaded that if further investigation be judiciously pursued it will tend to dissipate much of the error and superstition which still linger in our rural population, for I am inclined to believe that most of the tales respecting "will-o'-th'-wisps," "corpse-candles," and "lantern-men," are the result of occasional luminosity assumed by birds of nocturnal habits that frequently fly over marshy ground in search of prey.

and around church towers, ruins, and hollow trees, especially where ivy and yew trees exist, wherein they take up their abode in the day-time.

As long ago as February 3rd, 1907, one of these luminous birds was seen by my son and myself, as we were returning to Foulsham from a walk to Guist Hall. On reaching the top of Twyford Hill we noticed a light apparently moving in the direction of Wood Norton, and about a quarter of a mile to the north of us. After moving horizontally backwards and forwards several hundred yards, it rose in the air to the height of forty feet or more; it then descended and again went through the same evolutions many times. The light was slightly reddish in the centre, and resembled a carriage lamp for which we at first mistook it. We watched it for twenty minutes and were quite at a loss to ascertain its cause.

On December 1st, 1907, when again reaching the top of Twyford Hill, I noticed what I took to be the lamp of a motor bicycle moving rapidly along the Bintree road to the south. The light suddenly stopped, rose into the air above the trees and retraced its course. This it did several times, sometimes rising twenty to forty feet into the air, and then rapidly descending. I called my groom and his wife from their cottage a few hundred yards away, and they watched it with me for several minutes. I then went to my house about half a mile off, and from one of the attic windows watched it with my son and three servants for a short time.

My son and I then went to the Twyford Lane accompanied by Brownsell, an intelligent labourer, where we saw the light moving to and fro across a field in which were a number of turnip heaps covered with straw. We walked towards it, when it evidently became alarmed, and flew alongside the brook, disappearing in a plantation near Twyford Church.

About 10.30 the same evening, I cautiously approached this place, and, after waiting about ten minutes, the light emerged from a covert about 200 yards distant, flying backwards and forwards across the field, at times approaching within fifty yards of where I was standing. It then alighted on the ground for a few seconds, but before I could cover it

with my telescope it rose and settled again about 100 yards further into the field. Twice it passed across the field of view of my glass, when it looked like a large lamp. A slight mist hung over the ground.

On December 22nd I was walking along the Fakenham Road, near Chop Lodge, Twyford, when I saw a light moving over some meadows to the south. I called at Twyford Hall, when Mrs. Hamond and her daughter came out and watched it with me. It suddenly rose high into the air as if frightened, and disappeared in the direction of Guist Church.

On the 25th, 26th, and 28th December, it was seen by L. E. Leany, our schoolmaster, L. Allen, stationmaster, W. Palmer, p. c., Bird, E. Girling, myself and others, all residents in Foulsham.

On December 19th, when Dr. Herbert, of Foulsham, and his son joined me for a walk, we observed the best display. About 8 p.m., the evening being dark, the bird issued from the covert I have before mentioned. Its luminosity seemed to have increased, and it literally lighted up the branches of the trees as it flew past them, occasionally mounting over their tops. After watching it for about half an hour, it was joined by a companion bird hardly so bright. This kept about 100 yards behind it, but not constantly. Eventually both disappeared in the trees near Twyford Church. The same evening it was seen by Mrs. A. Digby of Fakenham, her daughter, and Miss Lee-Warner.

The night following, it was seen by Mrs. Chas. Hamond of Twyford Hall, Miss Lee-Warner, Mr. Philip Hamond of the Norfolk Regt. and Mr. E. Hamond, Lieut. R.N., in the Station Meadow, where it alighted on a post by the stream. I saw it hawking along the bank of this brook about 11 p.m. the same evening.

On January 5th, 1908, at about 8.30 p.m., Mrs. Purdy saw both birds hawking over Palmer's Field for several minutes. One of them flew towards the station, the other passed quite over her head and then rose rapidly and flew towards my plantation. It seemed far brighter as it approached her than after it had passed. They were seen

the same evening at 11.30 by Mr. Cyril Morton. Mr. Harold Morton of Foulsham Rectory, and Mr. H. W. Pollatt, of the Green, Banbury, Oxon., hawking around Blyth's stacks south of the station.

On the 16th January, W. Palmer's son saw one at 6 a.m. in Adam's ground. It passed within a few yards of him. He said there were two intensely bright spots on its head. It was uttering the quickly repeated "chuck chuck" of the White Owl, and was flying towards the Twyford plantations. One was seen on the 17th and 19th January at 8 p.m. by W. Palmer, p. c., also on the 24th by Allen, the stationmaster, Gooch, G.E.R. signalman, and Wright.

On February 4th it was watched for some time by the Rev. Hewetson of Bintree Rectory, and Sexton, miller, Foulsham, hawking over the meadows by the stream. On February 5th both birds were seen by Mrs. Maddison, wife of Mr. H. G. Maddison of Foulsham, Chemist. On February 6th Allen and I saw one at 10 p.m. On the 9th, Edward Keeler of Paradise Cottages, Foulsham, saw one flying round the spinney at the end of the Common Piece.

The occasions on which it was seen previous to December 29th, 1907, I mentioned in a letter to the 'Field'* signed with my initials, without giving the names of either persons or locality.

Apart from the evidence given above, I would point out that the letters of "Country Teacher" in the 'Times,'† and of Fred. Rolfe in the columns of the 'Eastern Daily Press,'‡ afford ample corroboration of the fact that the occurrence has been noticed before in Norfolk and elsewhere.

I have recorded these observations merely in the hope that some naturalist may be found whose scientific attainments will enable him to elucidate the cause of a highly interesting natural phenomenon, and thereby refute the contemptible assertions of those who pour ridicule on everything they have not seen themselves, to the great detriment of scientific research.

* 'The Field,' Jan. 11th, 1908. † 'The Times,' Dec. 26th, 1907.
‡ 'Eastern Daily Press,' Jan. 16th, 1908.

In addition to the names of persons already mentioned, the birds have been seen by the following witnesses :—

T. R. Blyth of Foulsham, Builder.
G. Blyth of Foulsham.
Miss Blyth ,,
Miss Austin, Twyford.
Miss Scofield, Bintree Rectory.
Mr. F. S. de Chaumont of 39 Pallister Road, W. Kensington.
F. Bayfield of Foulsham.
P. Berwick ,,
C. Durrant ,,
J. Loveday ,,
S. Vince ,,
E. Sainty ,,
W. Hart ,,
Dan. Herod (Guard).
Miss Priest, Foulsham.
Miss Maddison, Foulsham.
Miss Woodhouse ,,
Miss Dack ,,
Sergt. Kennedy of Foulsham.
E. Childerhouse, Guard, G.E.R.
C. Joyce, Chop Lodge, Twyford.
E. Austin, Twyford
B. Farrow, ,,
G. Farrow, ,,
E. Stratton, Porter, G.E.R. Foulsham.
H. Armour, Foulsham.
W. Southgate, Telegraph Clerk, Foulsham.
G. Graver, Gardener. Foulsham.

NOTE.—Since I read the above paper at the meeting of the Society on the 25th February, the birds have been seen on several occasions.

On the evening of March 1st. one was seen perched on a tree by Dan: Herod. Geo: Graver, G. Farrer, and others. They watched it for some time, and then it flew off, and after hawking over the field, it rose high into the air and disappeared in the direction of Twyford.

On March 2nd, both birds were seen by W. Palmer. p. c., hawking along the side of the stream between Twyford and Guist.

On March 5th. at 10.30 p.m., I saw one of the birds flying over one of Mr. Hamond's fields.

On March 10th, one was seen by W. Palmer. p. c., at 8 p.m.

On March 12th. two were seen by the Rev. and Mrs. Parker

of Twyford, who watched them for half an hour hawking along the valley between Twyford and Guist.

It has also been seen hawking over the land between Paradise and Kendle's farm, and along the stream in the direction of Bates' Moor.

The last records I have of the appearance of one bird is the 26th March, seen by Mrs. Bayfield, Mrs. Howell, and E. Keeler, flying across the Foxley road in the direction of the Hegg grazing grounds, and on the 28th March one was seen by Keeler hawking over the Hegg grazing grounds which he watched for some time, when it disappeared in the direction of Themelthorpe.

April 28th, seen by W. Palmer, p. c., at 9 p.m., and again at 11.30 p.m., when it passed within 30 yards of him at Twyford.

May 3rd. Seen by Palmer and myself at 11 p.m. hawking over meadows by Hegg.

VIII.

NORFOLK NEOLITHIC HARPOON-BARBS AND TRIANGULAR KNIVES.

By W. G. Clarke.

Read 28th January, 1908.

In the 'Antiquary' for September, 1907, Mr. A. E. Relph, M.R.C.S., L.R.C.P., pointed out that in all probability some of the Neolithic single-barbed arrowheads, and implements of similar form but unknown use, were originally made as harpoon-barbs, and the chipping of the specimens referred to certainly supports that view in many instances. It is not, however, applicable to all, and a single-barbed lance-head found by Mr. C. Chambers on the northern shore of Lake Lothing, Lowestoft, and another found by myself at Great Snarehill,

seem too thick and bulky to have been used in this way. Two Norfolk specimens in my collection can, however, I think be safely described as harpoon-barbs. One found on Santon Warren has been previously described * as an awl. It is of light yellow flint, highly polished. The base is extremely thin and with the sharp edge taken off either by intent, or by being forced into the side of a harpoon-shaft. This base is one inch in length; one straight edge of the same length is beautifully chipped on both sides, and a deeply concave edge, likewise chipped from both sides is just under an inch in length. The other implement is of light mottled yellow flint, with a thin base, chipped or worn, 1½ in. in length, a beautifully chipped and slightly convex edge just over 1½ in. in length, and a concave edge ¾ in. in length. Both the latter are splendidly chipped on both sides, and the junction between them forms a stout curved barb. This implement is from Thetford Abbey Heath. It seems probable that these barbs were fixed in slits in the sides of the harpoon-shaft, the ends being bound with green sinews which when they contracted would bind the barbs with the utmost security. These would have the concave sides facing the base of the shaft, and as the strain would be on the ends of the barbs, that is where they are most usually found broken. An arrowhead may have been used to point the harpoon, but as the object in the first place is to get the weapon as deeply imbedded as possible, I would suggest that an implement such as one I have from Bromehill, Weeting, would be more efficacious. It is 1⅜ in. in length, and slopes from the point to a base slightly over half an inch in width. It is flat-backed and bulkiest in the middle from which it slopes to point and base, the latter being thin, so that it could be fixed in the end of a shaft.

The occurrence of these implements so far inland may be accounted for by the fact that Neolithic man had probably a much wider range of usefulness for the harpoon than is known to us. All three were found on the banks of the Little Ouse marshland, and as the tides regularly flowed to Wilton until Denver Sluice was constructed in 1652, and

* Trans. Norfolk & Norwich Nat. Soc. vol. vi. p. 29.

huge sturgeon were caught at Thetford in 1715 and 1737, even in late Neolithic times—the period to which these implements belong—there may have been prey for harpoonists in the fresh or brackish waters of the Little Ouse valley.

There is another class of implement fairly common in Ireland, but in England almost confined to the arenaceous areas of south-west Norfolk and north-west Suffolk, some of which may perhaps have been used as harpoon-barbs. These implements are now generally known as triangular knives, though formerly classed as arrowheads, and American archæologists have made a line of demarcation by classifying as knives those with rectangular bases, and as arrowheads those with oval bases. Such triangular implements have been found at Gurob, Egypt, in remains of the XIIth Dynasty (2600 B.C.), are very common in the United States, Ireland and Scandinavia, but rare in Britain. Sir John Evans figures an almost perfectly triangular form, of rare occurrence, from near Lakenheath. It is neatly chipped over both faces, which are equal in shape. In the Salisbury Museum there are triangular arrowheads and others hollowed out at the base, remarkable for the fineness of the surface chipping and the extreme correctness of outline. Most of these are now classified as triangular knives. With the exception of one found by Mr. W. A. Dutt on Bungay Common, all the East Anglian examples I have seen came from the "breck" district. I have examined about 50 specimens and find that the greatest length of any one side is 2 inches, and that the average is between $1\frac{1}{4}$ in. and $1\frac{1}{2}$ in. They may be divided into three classes: (1) those chipped all over both surfaces, (2) those worked on two edges only, but on those edges worked both sides, and (3) those with hollow bases. Those chipped all over both surfaces generally give evidence of most skilful workmanship and are frequently equilateral. They are most beautiful little implements and may have been used as hafted knives or as arrowheads. A sub-division is chipped around the three edges on both sides, but not on the surfaces. Those that are hollow-based are generally chipped only on the edges. The most interesting examples, however,

are those chipped on two edges and on both sides of the implement, while the third edge is either chipped most minutely or not at all. Many of these have one straight edge, one convex edge, and one concave edge, the two latter forming a curved point. It has been suggested that some of these are barbed arrowheads in course of construction, but the fact of one side being concave and the other convex in nearly all cases seems sufficient to dispose of this theory. Considered as harpoon-barbs there would be reason for this chipping. The unchipped edge or even a thin chipped edge would be fixed in the side of the harpoon-shaft, the convex edge would be towards the point and the concave towards the base, thus making a barb, which in some cases has received specially detailed treatment.

IX.

SOME BRECKLAND CHARACTERISTICS.

By W. G. Clarke.

Read 25th February, 1908.

Though much of south-west Norfolk and north-west Suffolk consists of open country with sandy soil, there are certain features peculiar to a district frequently termed "Breckland," because of the number of "brecks" within its borders. On the west, beyond Methwold, Feltwell, Hockwold and Lakenheath, it is bounded by the fens: on the north by the river Wissey: on the south by the river Lark: and on the east by lines drawn from Watton and Bury to Blo' Norton. This area contains about 225 square miles. 31 Norfolk and 25 Suffolk parishes, or one to about 4 square miles. This is chiefly because of the parishes near the border streams, and

on the slightly better land in the eastern portion of the district; in a track of 42 square miles south-west of Thetford there is but the solitary village of Elveden. It is a land of heath and warren, those of some size in the Norfolk portion numbering 25, and in the Suffolk part 18. Almost all these are on chalk spurs of the East Anglian Heights, and vary in altitude from a foot or two above the level of the alluvium in the river-valleys and of the fens—which close by the western border are + 8 ft. O.D.—to 169 feet near Thetford Waterworks, 170 feet at Croxton Vicarage, 179 feet at Frog Hill, West Wretham, 185 feet on Sturston Warren and 189 feet where the road from Merton turns to Tottington, in Norfolk; to 173 feet, half a mile south of Barnham and at Shelterhouse Corner, Elveden, 177 feet half a mile south-east of Rymer Point, 182 feet $7\frac{1}{2}$ miles from Thetford on the road to Barton Mills, and 183 feet immediately south of Culford Heath, in Suffolk. Nevertheless the long heathland slopes rising from the valleys of the Wissey, Thet, Little Ouse and Lark make the apparent altitude greater than the real, and extensive views are sometimes obtainable. From Bromehill, Weeting, Ely Cathedral is plainly visible 16 miles distant; from Thetford Waterworks, Ickworth Building can be seen at the same distance; and Swaffham Church is also distinguishable from Croxton, a distance of 14 miles. The rivers have very few tributaries. There is none on the north bank of the Lark from West Stow to the fenland, a distance of 10 miles; on the south bank of the Little Ouse there is none between Euston and the fens, a distance of 14 miles, and on the north bank with the exception of the Thet and a stream less than a mile in length at Weeting, there is none within the confines of the district. On the south bank of the Wissey, west of Watton, there are three small tributaries, the only one of any importance being that which rises at Merton and flows through Thompson and Stanford Waters. It is probable that surface water passes directly into the streams through their sandy banks or beds. Heathland pools, known as meres, form one of the most remarkable features of the district, but with these I have dealt in a previous

paper.* By the edge of an over-grown clay-pit immediately east of Grimes' Graves Plantation there is a curious little hollow perennially filled with water, and used to a great extent by birds and animals of the adjacent heaths.

The fauna and flora of the river-valleys is similar to that of other parts of East Anglia, and in the woods and plantations —except so far as they share in the wild life of the country around—there is nothing particularly noteworthy; it is on heath and warren that we come in contact with the peculiar features that render the district so interesting to the naturalist.

It is difficult to reconstruct the appearance of this part of the country in early times, but from the nature of the soil it is probable that most of it was almost treeless until the beginning of the 19th century, with a considerable proportion of heath and warren; the extent of the cultivated portions varying largely from time to time. Domesday Book shows that at the Survey the neighbourhood of Hockwold, Feltwell and Methwold, was remarkable for the number of hives of bees kept there. Hockwold and Feltwell each had 17, while Methwold with 27 had more than any other place in Norfolk, facts not improbably due to the quantity of heather near by. On the upland plains there were also herds of wild horses, 220 at Great Hockham and 63 at Tottington having been recorded in the time of Edward the Confessor, a total reduced to 15 when the Conqueror's Survey was made. There was woodland at various places in the eastern part of Breckland, Merton alone providing pannage for 240 hogs. During the next three or four centuries most of the local deeds contain references to "brueria," that is, unproductive ground covered with heather and gorse. The cultivated areas near the towns and villages were farmed—as was the case until about 1800—on the open-field system, by which the arable fields were "shack" land for six months of the year, and during the remaining period were divided into strips of about an acre each held by different persons. Economically it was wasteful, but it enabled a large proportion of the community

* Trans. Norfolk and Norwich Nat. Soc. vol. vii. p. 499, *et seq.*

to be agriculturists, and old documents prove that land now for the most part absolutely barren, was in the 13th, 14th, and 15th centuries profitably cultivated. As an instance of the changes which have taken place it may be mentioned that in 1272 there were in the Suffolk part of Rushford at least 15 farmers of from 15 to 40 acres of arable land, with rights of sheep-feeding extending over 500 or 600 acres. It was then all occupied by small holders ; to-day it forms a small corner of an estate covering some 18 square miles. In the days of the open-field system of cultivation the manurial value of marl was well-known, and some of the pits whose existence in the middle of heathy tracts is now almost inexplicable, were originally dug to obtain marl for the adjacent arable land. There was in 1338 a Lampythowe on Thetford Warren (marked Lambpit Hill on the O.S. map), and the original loam-pit to which the name refers is still a scene of occasional activity in the middle of that waste. Beyond the borders of the fields were heaths and rabbit warrens, the district having always been noted for its rabbits. The open-field system was fruitful of disputes between the manorial lords and the owners of common rights, and the following plaint is but typical of many. Writing to Lord William Howard in 1595, Robert Buxton of Shadwell said : " The fold courses about Thetford be 100 markes by year worse than of late they were, for where the township were wont to keep but twenty milch neat and three or four horse, they have now above one hundred of the one sort and four score of the other, and daily spoil the ling and furze, and the longer they be suffered, the worse and harder to be reformed, so as the grounds that were before several are now common." This is interesting as indicating that the fold courses consisted of ground on which heather and furze abounded.

Early in the 17th century this district became a favourite resort of King James I., for hunting and hawking, and in 1605 some notice appears to have been issued forbidding interference with game in the neighbourhood, for Lord Cranborne (in a letter to Sir Thomas Lake) thought malicious people might make bad use of it, " as tho. he claimed all

for his own." Lord Cranborne, however, wonders "that any churl should kill anything that might afford his majesty his only recreation." This notice appears to have been somewhat ineffective, for in 1607 instructions were sent to Sir Nicholas Bacon, Sir W. Walgrave, and Sir Robert Drury to take measures for the preservation of the King's game in the parts of Norfolk and Suffolk within twelve miles of Thetford, offenders to be brought before the King or the Privy Council. Three years later the Duke of Wurtemburg came to Thetford with the King, and they "coursed the hare flew a hawk, and caught dotterels," and watched trained cormorants catch fish in the river. In 1611 Thomas Cockayne was appointed for life keeper of the game on the rivers at Thetford, and at Royston, and in 1614 John Coward and his son were appointed keepers of the stags and hawks about Thetford. A warrant was issued to Sir Thomas Germaine in 1626 to preserve King Charles the First's game within five miles of Thetford, and on February 17th, 1636, Sir Lionel Tollemache was ordered to preserve the king's game of "hare, pheasant, partridge, and other wild fowl" in Thetford and Ipswich, and within 12 miles thereof. After this there is no evidence that Thetford was used as a hunting centre by royalty. For pheasants we must suppose that there was woodland of some kind, and trees in Fakenham Wood, and at Shadwell and Merton probably furnish evidence of ancient forests within the area known as Breckland.

Yet that most of this was then open country is proved by various witnesses. In Camden's 'Britannia' (1586), Norfolk is described as "almost all champion," and the soil in the west as "poor, lean, and sandy." In the account of Norfolk which Sir Henry Spelman wrote for John Speed in 1627 he said: "The Champion aboundeth with Corne, Sheepe and Conies, and herein the barren heaths (as the providence of our Ancestors hath of old disposed them) are very profitable. For on them principally lie our Fould courses. . . . . These Heaths by the compasture of the sheep (which we call Tathe) are made so rich with corne, that when they fall to be sowne, they commonly match the fruitfullest grounds in other

countries, and laid againe doe long after yield a sweeter and more plentiful seede for sheep ; so that each of them maintains the other, and are the chiefest wealth of our Countrey." Writing about 1662, Sir Thomas Browne referred to this as the " Champian and feildie part," mentioning the occurrence on the heaths of the district of cranes, great bustards, shelduck, dotterel, plovers " green and grey, in great plentie about Thetford and many other heaths," and stone curlews. In 1668 there was a great sandstorm at Downham, the sand travelling five miles from Lakenheath Warren, almost overwhelming the village, and for a time blocking up some three miles of the course of the Little Ouse. Downham consequently obtained the prefix of Sandy, now corrupted to Santon. John Evelyn visited Euston in 1671 as the guest of Lord Arlington, and described the soil as " drie, barren, and miserably sandy, which flies in drifts as the wind sits." In 1677 he went to see " the Travelling Sands about ten miles wide of Euston, that have so damag'd the county, rouling from place to place, and like the Sands in ye Deserts of Lybia, quite overwhelm'd some gentlemen's whole estates." The map in Ogilby's ' Britannia ' (1675) shows " Sheep Downs " between Thetford and Brandon, " open way " between Thetford and West Tofts, and " warren " and " heath " between Thetford and Barton Mills. Blomefield, the Norfolk topographer describes South-west Norfolk as " Filand," that is " field land," which he explains is a tract of unenclosed arable land. Kirby in the ' Suffolk Traveller ' (1757), denominates the district the " Fielding Part " of Suffolk, and says, " most of it is in sheepwalks, yet affords good corn in many places." He frequently refers to " champaign lands " in the vicinity of Thetford.

It seems certain that in the middle of the 18th century the amount of arable land was small, was fallow for six months of the year, and that the " tracks " which for the most part served as roads, were unbounded by hedges, and often by banks. Most of Breckland was then a treeless waste. It is obvious that travelling was, under such circumstances, beset with difficulties. Some evidence of the inconveniences is furnished

by the 'Memoirs of a Royal Chaplain.' On September 19th, 1735, Charles Kidman, maternal uncle of the Rev. Dr. Samuel Kerrich, rector of Dersingham, drove from that place to Banham. He afterwards wrote: "At half an hour after 4 we proceeded in our journey from thence (Watton), taking a guide to Shropham. Then we took directions, but failed in observing them and wandered upon Snetterton Heath for an hour or two, and then went to Wilby instead of Eccles, where we were at a great loss where we were, and continued so till Harry took out one of ye horses in ye quest of some house, who after half an hour lighted upon Mr. Hare's, who sent his man with a Lanthorn and Horse to direct us hither." In August, 1754, Dr. Kerrich left Dersingham on a visit to Cambridge going by way of Swaffham and Newmarket. He had to leave Swaftham at 5 a.m. on account of crossing "the horrible Brandon sands" in the cool of the day, to avoid distressing the horses. These heaths it may be mentioned in passing, were a resort of highwaymen, from the parson of Wretham who was caught at his malpractices early in the 15th century, those who robbed Augustus Briggs, M.P., in 1669, the murderers of Bryant Lewis—whose tragical epitaph is in St. George Colegate Church, Norwich—in 1608, to the one who about 1800 endeavoured to overawe Mr. Mottram of Gurney's Bank, who was taking some gold across Thetford Heath, was shot dead, and found to be armed with a brass candlestick.

A number of witnesses give evidence as to the nature of the country at the end of the 18th century. Mr. Arthur Young estimated that 220 square miles of Norfolk consisted of light sand and 420 miles of good sand, much of the former being in the south-western portion of the county. Kent in his 'General View of the Agriculture of Norfolk' (1796), says that the Hundreds of Shropham, Guiltcross, Wayland, South Greenhoe, and Grimshoe, "consist of a light sand, so light indeed in Grimshoe Hundred that it frequently drifts in the wind and is bare of vegetation," and in 1797, Mr. William Kirby, M.A., F.R.S., the entomologist, said, "The country here affords few or no objects to relieve the mind from

the tedium which its bleakness and sterility produce upon it. It may be denominated an ocean of sand producing little besides nettles and brakes, with here and there an islet of firs."* Late in the 18th century the plantations through which the road runs to make the Elveden "gaps" were planted, and were said to be the earliest Scotch firs in the district. The 3rd Duke of Grafton (1735-1811) had a great aversion to the broad ditches with their honeycombed banks, and used to call them "Suffolk graves," and the 6th Earl of Albemarle, who records this in 'Fifty Years of my Life' (1876), adds that "the whole country is a mere rabbit warren, and still goes by the name of the 'holey land.'" About the same period we have Robert Bloomfield's references in 'Barnham Water' (1802), to "the bleak, unwooded scene," "the barren fields," and the "slope of burning sand." Britton's 'Description of the County of Norfolk' (1819), mentions the "great expanse of heath and unenclosed land, stript of every timber tree." In 1820 there were no trees between Thetford and Elveden, and Thetford and Brandon, and about this time there was a sandstorm of such severity that the particles broke over 100 panes of glass in a coach-builder's establishment on London Road, Thetford. Before proper roads were made on these wastes there was real danger in trying to follow the tracks under certain weather conditions. Several lives have been lost owing to snow rendering landmarks unfamiliar and necessitating a night's exposure on the wilds. Writing in his diary on March 23rd, 1837, Mr. J. D. Salmon, F.L.S., of Thetford, said, "Heavy fall of snow. A very bad journey from Lakenheath in ye evening. Could not see my way, there being no tracks. Fortunately I did not get off the road."

As a result of the passing of local Enclosure Acts in the late 18th or early 19th century, many portions of ancient heath were broken up and became "brecks." In the century or so that has since elapsed, there have been many changes in their appearance. Some have been sub-divided and fenced, and

* 'Life of the Rev. W. Kirby, M.A., F.R.S., F.L.S., Rector of Barham. By John Freeman, M.A. (1852), p. 107.

now appear as ordinary enclosed fields on light land farms: others have remained unfenced, but are still cultivated; while a considerable number which were first broken up when the high price of corn made it profitable to the farmer, have long since been allowed to revert to their primitive barrenness, and are now areas on which stones or bents are the most prominent objects according to the time that has elapsed since they were last cultivated. It is possible to tell the comparative time since a "breck" was cultivated by the size of the stones upon the surface, year by year the vegetation covering stones of larger size, so that those derelict but a few years are covered with stones both large and small, while those which have not been ploughed for a generation have only the largest flints visible. Within the past decade big areas of heath and derelict "breck"—notably on Rushford, Knettishall, Snarehill, Melford, Roudham, and West Tofts Heaths, Brettenham Drove, and on the Elveden estate—have been brought under cultivation by the steam plough.

In the middle of the 18th century unenclosed land extended almost unbrokenly from Attleborough to Mildenhall, and from Watton to Bury St. Edmunds. Roads were few, but tracks were innumerable, branching off one from the other and pursuing their erratic courses, sometimes to a goal, sometimes not. Some were more used than others, but none was a made road, and vehicles of any weight often sank up to the axles in the sandy soil. Many bye-roads have been closed and such ancient tracks as the Icknield Way, Peddar's Way and the Drove, are partially obliterated and falling into disuse. With the exception of some islets of Scotch firs (*P. sylvestris*) most of the heathy part of the district was a treeless waste, beloved by the great bustard and the stone curlew. Since about 1840 trees have been planted in enormous numbers, sometimes as fir "belts" which are so characteristic a feature of the scenery, often as plantations of Scotch firs, larch, spruce, and to a less extent of silver birch, beech, elm, and oak. Hedges are infrequent and sometimes consist of Scotch or spruce fir, a feature of the district that is almost unique. These hedges are made of ordinary trees kept stunted

by constant trimming, and many of the lines of fir trees now bordering plantations were originally hedges, but have ceased to be trimmed. Within the past three years about 10 miles of spruce hedges have been planted on the Shadwell Estate. The estates have tended to become bigger and bigger and the whole area of Breckland is now owned by a comparatively few people. One estate covers roughly 26 square miles of country, another 20, and a third 18. Within the past ten years many miles of roadway previously open to the fields have been fenced. and the district does not, in consequence, appear so open as formerly. Nevertheless, Breckland is still the wildest district in Norfolk or Suffolk. Writing in 1872, Mr. S. J. B. Skertchly said : " From Thetford to the Fens, so barren is the land that one is often reminded of the deserts of Africa, rather than of English scenery. Hardly a drop of surface-water is to be found, and for miles there is neither ditch, pond, nor spring." The Rev. C. Kent also says : " I have spent a month in the Sahara, and the part near Brandon reminds me vividly of it." All the heaths are, however, broken up by boundary banks, some of them 6 or 8 feet in height. Few of them have meaning for moderns. Some mark parochial or hundred boundaries ; of the remainder some perhaps bounded trackways originally marked off thousands of years ago ; others are the boundaries of the ancient common fields.

Soon after the close of the glacial period much of this district appears to have bordered salt-water creeks which formed part of the sea that then covered the fenland, creeks represented by the valleys of modern streams and by divergent valleys now dry. That the fen basin then stood somewhat lower than at present is shown by the existence of gravels containing marine shells at March and other places in the fen plain. Mr. F. W. Harmer, F.G.S., informs me that the level of these beds at March is about 15 feet above O.D. and they contain, with the non-British shell *Cyrena fluminalis*, a fauna somewhat more boreal than that of the North Sea at present, and while newer than the chalky boulder clay, probably late Pleistocene rather than recent. There are also in the Fenland several shell-bearing deposits more recent

than these gravels, and representing the period when most of the fen plain was covered by brackish or tidal waters, dotted with more or less isolated patches of dry land.* Many of the present heaths and warrens of Breckland were thus post-glacial beaches and sand-dunes, and have retained a fauna and flora that is in some respects quite unique in England, for with the sea at its nearest point (the Wash) 18 miles distant from Methwold, various plants and insects typical of the sand-dunes still flourish, and nowhere else in England does the ringed plover breed inland. But though this distribution of fauna and flora probably originated in the post-glacial period, it is possible that a favourable influence in its perpetuation may have been exercised by the salt tides which, before the construction of the first Denver Sluice in 1652, regularly came up to Wilton Lode and doubtless to corresponding distances up the valleys of the Wissey and Lark, and would probably render the water brackish for some miles beyond. In a map of the Bedford Level in 1789—kindly lent me by Mr. Arthur Bennett, F.L.S.—the north bank of the Little Ouse between Hockwold and the present Crosswater Staunch is marked as "Sea Fenn." There is also a tradition among the inhabitants of Hockwold that folks used to climb to the top of the church tower "to see the ships across the fens." Part of Methwold adjoining the fen is still known as "The Hythe"; the fen part of the Little Ouse is often called "Brand Creek," and that of the Wissey "Hilgay Creek"; and part of the heath between Barnham and Elveden was formerly called "The Denes" by agricultural labourers of the neighbourhood.

At the present day the surface soil over most of the area is a thin layer of sand, in some parts covering boulder clay of no great thickness—the average depth being about 12 feet—and in others resting directly on the chalk. The sand varies in thickness from a few inches to several feet. When at least 6 to 8 inches deep it is considered possible to cultivate it, but when very thick it absorbs moisture so rapidly as to be

* Marr and Shipley's 'Natural History of Cambridgeshire' (1902), p. 138.

of little benefit to the agriculturist. Much of the sand is probably wind-drifted, derived in part from patches of drift sand occasionally found on the boulder clay, and in part from the decomposition of the sandy boulder clay itself. Mr. C. G. Barrett described it as "a loose light sand precisely such as is found on the North Denes at Yarmouth at the present time" * (1870). This forms a perfect filter-bed, absorbing water with great rapidity, and even during the heaviest storms pools of water never form on the heathland. Villages on the high lands are consequently very healthy, and the large open areas of sandy soil seem to invest the air with tonic properties usually associated with the mountains or the sea-coast. Mr. H. Dixon Hewitt. F.I.C., informs me that this sandy soil frequently contains 88–89 % of silica and insoluble matter from the clay. Its chief characteristic is the very low proportion of potash, at once disproving a theory which has been put forward, that the peculiarities of flora are due to the quantity of felspathic debris, as this contains much potash. In the boulder clay itself there is usually a goodly proportion of potash derived from ground-up igneous rocks, but this seems almost all to have been removed from the sand. Considering the coast fauna and flora it would, however, be interesting to ascertain what proportion of sodium chloride these sands contain compared with others from inland localities. Before trees were planted, sandstorms, especially during westerly and south-westerly gales were frequent, the soil being light and dry and freely exposed to the influence of wind and sun. The writer of the article on the "breck" district in Vol. I. of Stevenson's 'Birds of Norfolk'—I am informed by Mr. T. Southwell, F.Z.S., that this was probably Professor Alfred Newton, F.R.S.—said: "The effect of high winds after dry weather in this district is not easily described. The whole air is filled with sand till it resembles a London fog." Real sandstorms are now chiefly confined to Lakenheath and Wangford Warrens and parts of the heathland near Icklingham, but in high winds sand is blown from the surface of the fields quite across the roads, sometimes forming drifts a foot

* Trans. Norfolk and Norwich Nat. Soc. vol. i. p. 62.

or two deep. On the big open fields millions of tiny particles of sand are carried along, making a distinctly audible musical tinkle as they strike each other. By a process of selection the tiniest particles are carried furthest and down the short slope of a boundary bank form cascades of purest golden sand. Every depression in the soil is brought into strong relief, and where the sand is exposed to the force of the wind it is rippled like the wave-ripples on some peaceful seashore.

On many of the heaths, plants ordinarily to be found in such situations occur more or less abundantly, but there are many varieties. Nowhere in the district does the fine-leaved heath (*Erica cinerea*) or *E. tetralix* grow, but the heather or ling (*Calluna vulgaris*) is very abundant. It is not so common where the chalk is near the surface, as where the surface soil is deeper or there are deposits of gravel, calcareous matter being prejudicial to vigorous growth. In some places, such as on the north-west corner of Thetford Warren and parts of Santon Downham Heath and Park Heath, Croxton, the heather occasionally attains a height of 18 inches. White heather has been found on Croxton and Santon Downham Heaths. Bracken (*Pteris aquilina*) is, however, the most widely distributed and abundant plant of the heath and woodland, sometimes in favourable seasons, such as 1907, attaining a height of 10 feet, and always of 7 or 8 feet, in many of the plantations, being generally higher among trees than on the open heath. It is certainly the dominant plant of the "breck" district, and on several heaths has usurped the position which heather occupied some 20 years ago. Bracken lacks its former economic importance. In the time of Queen Elizabeth the Jury of the Leet at Thetford decreed that "All the brakes growing in Little Norwick and between the said Little Norwick and the Abbey shall year and yearly be reserved to be cut and gathered by the poor of the said borough with their sickles." Any person who offended against this regulation had to forfeit his brakes and pay 3s. 4d. fine. About the same period the Jury of the Leet also decreed that "the poor of the town are ordinarily very much distressed for the want of fuel in the time of winter by reason of the

immoderate course of some who, seeking their own benefit, leave nothing for the rest, therefore every year it shall be lawful for every householder or resident within the town, by himself or deputy, to enter into the common brakes, the Monday, Tuesday, or Wednesday after Holy Rood Day (September 14th) to take so many brakes, as by the only labour and pains of one man in the mowing, may be conveniently cut down and no more." Any offender was to forfeit the brakes and not be allowed to cut for six years following. A similar custom formerly existed on many of the heaths but has been allowed to lapse. On Lakenheath Warren there are, however, still 84 "rights," the lord of the manor holding the largest number, entitling the holders to cut brakes and sand-sedge after August 29th. Each "right-holder" is supposed to have ten acres, but as there are no boundaries, it means in practice that each man cuts where he chooses. On thousands of acres, nevertheless, the bracken shoots up in spring and dies down in autumn without being utilised by man in any way. Gorse is not by any means so abundant and large bushes appear only to be found on virgin heathland or on that which has not been under cultivation for a long period. Some of the bushes on Wretham, Wretham Thorpe, Brettenham and Santon Downham Heaths attain a large size. Sand-sedge (*Carex arenaria*) and the three plants named cover most of the heath area and represent either primitive heathland or the last stage in the reversion of cultivated land or rabbit-made desert to "bruery."

When land ceases to be cultivated or the rabbits which convert the warrens into sandy steppes are killed off, the first vegetation which appears is lichen, moss and stonecrop. On some hundreds of acres of Thetford Warren there is a most extraordinary growth of lichen, which for extent must be almost unique. Where the lichen is longer established and prevents the moisture in the thin layer of surface soil from being entirely evaporated, annuals spring up and perennials establish themselves. Among those earliest noticeable are *Senecio Jacobæa*—locally "canker-weed"—which in autumn covers with a golden mantle field after field which has

gone out of cultivation. The alien *Erigeron canadense* has also become a striking feature in the plant-life of the district, giving some of the sandy areas a decided tinge of green when the young plants come up in the spring. It grows abundantly in the neighbourhood of Merton, Weeting, Santon Downham and Thetford Warren and has also been recorded from Croxton and gardens in Thetford. When the rabbits were killed off on the Shadwell estate, vast quantities of oak and furze seedlings sprang up all over the heaths, and the season after such a procedure had been adopted on Thetford Abbey Heath its appearance was so changed as to be almost unrecognisable. An unusual phenomenon was also furnished by the ploughing of Rushford Heath—which had been fallow for about 20 years —in the winter of 1904–5. In the following autumn it was covered with a dense growth of *Reseda lutea*, intermingled with *Carduus nutans*, *Scabiosa arvensis*, and *Galium verum*. Before it was ploughed I had been over each year for several years in the autumn and had noticed no mignonette, yet suddenly on the soil being disturbed it covered scores of acres as thickly as though it had been planted. One can only surmise that the seed had been lying dormant for a long period. The following year the heath was sown and only a few mignonette plants have been observed since. In 1668 Sir Thomas Browne said, "this groweth not far from Thetford and Brandon, and plentiful in neighbour places."

Perhaps the typical plant of the district is *Cynoglosum officinale* and on some of the heaths the abundance of *Erophila vulgaris* is so remarkable that in May it actually gives a faint pinkish-white tint to the ground. Writing in 1847, Mr. Townsend* said of the country round Mildenhall, "The open woods consist principally of fir, and little else but nettles, stonecrop, and chervil (*Chærophyllum anthriscus*), which last is one of the most frequent weeds both of the woods and on the heaths, encircling the rabbit burrows with its welcome shade and climbing the sides of the tops of the mud walls in luxuriant profusion." The poorness of the soil tends to produce dwarf forms of many plants including *Erythræa*

* 'Phytologist,' vol. ii. p. 581.

centaurium and *Erodium cicutarium* of which there is a white-flowered form, while *Veronica officinalis* is not infrequently pink-flowered. Other heathland plants which have been recorded are *Botrychium lunaria*, *Apera interrupta*, *Phleum Bœhmeri*, *Aira præcox*, *Carex ericetorum*, *Orchis ustulata*, *Thesium humifusum*, *Nepeta glechoma*, *Calamintha acinos.* *Veronica arvensis*, *V. verna*, *V. triphyllos*, *Euphrasia nemorosa*, *Myosotis collina*, *M. versicolor*, *Gentiana campestris*, *Hypochæris glabra*, *Potentilla verna*, *Herniaria glabra*, *Scleranthus annuus* var. *biennis*, *Medicago minima*, *Hippocrepis comosa*, *Helianthemum chamæcistus*, *Fumaria densiflora*, *F. parviflora*, *F. Vaillantii*, *Papaver hybridum*, *Dianthus deltoides*, *Sagina ciliata*, *Thalictrum minus*, and *Anemone pulsatilla*.

Between the spring of 1906 and the end of 1907, Mr. H. Dixon Hewitt, F.I.C., of Thetford, found in the higher parts of the district *Thalictrum minus* var. *flexuosum*, *Papaver argemone*, *Arabis hirsuta*, *Alyssum calycinum*, *Sisymbrium Sophia*, *Teesdalia nudicaulis*, *Silene otites*, *S. conica*, *Sagina nodosa*, *Arenaria tenuifolia*, *Mœnchia erecta*, *Cerastium arvense*, *Hypericum humifusum*, *Ononis spinosa*, *Medicago falcata*, *M. sylvestris*, *Trifolium glomeratum*, *Astragalus Danicus*, *Vicia lathyroides*, *Spiræa filipendula*, *Potentilla argentea*, *Tillæa muscosa*, *Saxifraga granulata*, *Chærophyllum anthriscus*, *Caucalis nodosa*, *Asperula cynanchica*, *Erigeron acris*, *Filago spathulata*, *F. minima*, *Anthemis arvensis*, *Artemisia campestris*, *Campanula hybrida*, *Salvia verbenaca*, *Lamium amplexicaule*, *Scleranthus perennis*, *Chenopodium rubrum*, and *Ch. Bonus Henricus*.

The most remarkable feature of the flora is the survival from remote ages of marine, or rather sand-dune plants in a habitat which has long been abnormal. Agricultural operations by many generations have doubtless resulted in restricting the area originally occupied by these plants of the littoral, and many species have probably been eliminated in this locality in the struggle for existence. This peculiar feature in the life of the "brecks" was, I believe, first pointed out* in 1870 by the late Mr. C. G. Barrett, who drew attention to the fact

* Trans. Norfolk and Norwich Nat. Soc. vol. i. p. 138.

that in this inland locality were found insects whose normal habitat was the coast sand-hills from which they rarely wandered even for a hundred yards, the only thing to differentiate the "breck" specimens from those of the coast being their emergence a few weeks earlier, and in some cases, their brighter colours. Yet though coast insects are comparatively numerous, only seven species of coast-plants have been recorded, though one of these, the sand-sedge (*Carex arenaria*)—locally known as "net-rein" from its matted roots—is in places extremely abundant. As rabbits eat grass and not sand-sedge, where rabbits abound the latter has the best chance of increasing. Almost all these sand-dune plants have been found within a short distance of the alluvium by the courses of the present streams, and on a geological map it will be seen that most of these streams were at one time probably salt-water creeks from the fen basin. On the south bank of the river Lark the sea timothy grass (*Phleum arenarium*) has been found on Cavenham Heath, and *Corynephorous canescens* on Lackford Heath, while *Carex arenaria* occurs on Tuddenham, Cavenham and Lackford Heaths close to the marshland. It is also found on Icklingham Plains on the north bank of the river Lark, and on West Stow Heath where it grows in the greatest profusion, particularly between the road and the river. It furthermore occurs on all the heaths within a radius of three miles of Mildenhall, intermixed here and there with *Ph. arenarium*. On Culford Heath, which is about two miles distant from a patch of Lark valley alluvium at Wordwell, *C. canescens* and *Ph. arenarium* have been found and on Troston Heath a short distance from the stream which flows from Ampton Water into the Lark, *Ph. arenarium* and *C. arenaria* have been recorded. A narrow strip of fenland even now extends to Eriswell and this is the nearest alluvium to Weather Heath, some three miles distant, on which *C. arenaria* has been noted. Lakenheath Warren formed part of the eastern shore of the sea which covered the fen, and here *C. arenaria*, *Corynephorous canescens* and *Festuca ambigua* have been recorded, while another bay of the fen bordered the adjoining Wangford Warren, where *C. arenaria* is abundant. On heaths on the southern slope of the Little Ouse valley we

have *C. arenaria* in abundance on Santon Downham Heath, on the western side of which it grows in such profusion that it is burnt down each autumn so as not to afford cover for rats, stoats, and weasels. It is also very abundant on the borders of Santon Downham Heath and Thetford Warren and on the slopes of the former heath near the river. *C. arenaria* has been recorded from Elveden, where it covers large areas near Old and New Barnham Slips, and is also found on Thetford Heath (in Barnham parish) with *Festuca ambigua*. *Ph. arenarium* has been recorded for Barnham Heath and *C. arenaria* occurs in a patch at Euston about 100 yards south-east of the county bridge, and in abundance on Rushford and Knettishall Heath (Suffolk). Between the Little Ouse and Thet *Festuca ambigua* and *Ph. arenarium* have been recorded from Rushford Heath. The same grasses have also been found between Harling and Knettishall, probably on West Harling Heath. *Carex arenaria* grows abundantly near the pond in Shadwell Forest and also by the ancient ford of the Blackwater in Riddlesworth and Rushford. A patch of about two acres on the west side of the county bridge at Euston was broken up in 1905. On the northern bank of the Little Ouse, *C. arenaria* is common for about two miles north-east of Brandon station at the foot of the western slope of Bromehill, Weeting, in a patch at the top of the hill, and one immediately east of Grimes' Graves plantation, and at various places on the lower slopes of Santon Warren. There is a big patch at the foot of the eastern slope of Bromehill, by the "Drove" road, and another above St. Helen's Well, where the mounds which mark the ruins of St. Helen's Church—part of which was removed to another site in 1628—are now covered with a dense growth. *Festuca ambigua* has also been recorded from the same locality. Further up the valley *C. arenaria* occurs in patches on Thetford Two-mile-bottom Common, abundantly on the western side of Thetford Abbey Heath, and on the river slopes towards Thetford. There is also another patch on Wretham Heath north of Ringmere at the eastern end of a valley diverging from the Little Ouse valley at the Two-mile-bottom and passing immediately to the northward of Croxton village. *Carex arenaria* is also found

DISTRIBUTION OF MARINE PLANTS IN BRECKLAND.

BRITISH MUSEUM
NATURAL HISTORY

at Mill Hill in Merton Park not far from the Tottington and Threxton boundaries, and on "The Sheepwalk" north-west of Thompson Water, where a tumulus and several acres adjoining are thickly covered. The first locality is about a mile and the second about 200 yards from a tributary of the Wissey which flows through Thompson and Stanford Waters. Though beyond the bounds of Breckland, it is interesting to note that *C. arenaria* has been found on Swaffham Heath not far from the river Nar, and *Corynephorous canescens* on a patch of post-glacial gravel at Homersfield in the Waveney Valley, further evidence of saltwater creeks in the post-glacial period. Though not essentially maritime *Rumex maritimus* occurs much more frequently near the sea than inland. It has been recorded from Broadmere, Troston; Mildenhall; Fornham Heath (near Hengrave Park); Ringmere, and Langmere. *Erythræa littoralis* has been found at Brandon and between Wangford and Lakenheath, and *Vicia lutea* among lucerne at Brandon.

Though not a maritime plant *Phleum Bæhmeri* is very curious in its distribution, usually occurring on small raised pieces of land. South of the Lark it has been recorded from Kentford Heath; between the Lark and Little Ouse from Troston Heath, Eriswell, Weather Heath, and Lakenheath Warren; and between the Little Ouse and Thet from Rushford and West Harling Heaths.

We have Sir Thomas Browne's authority for the fact that Sheld-duck formerly bred in rabbit-burrows about Northwold and other places, but the only shore-bird that now regularly nests in the district is the Ringed Plover, and though it is fairly widely distributed, I am convinced that a reasonably accurate census of all the birds nesting in Breckland might be taken by any competent observer in a week of the nesting season. Unlike the sand-dune plants, the Ringed Plover has no restrictions which prevent it from extending its range and it certainly does not always nest on the same part of any given heath. It appears to have a preference for derelict "brecks," where the white stones spotted with black lichen render it practically impossible to distinguish its eggs. But when these lands are under cultivation a new nesting-place is sought. In 1897 and

for several subsequent years three pairs nested on a stone-covered "breck" on Roudham Heath, adjoining Peddar's Way. When this land was cultivated once more they apparently changed their nesting-site to East Wretham Heath, a mile westward, not far from Langmere. Should the "breck" once more go out of cultivation, they would not improbably return thither on account of the greater protection afforded to their eggs by a stone-covered area, than by ancient heath-land. I have noticed a similar preference on Thetford Warren, on the Spectacle Hangers, Santon Downham, and on Santon Square and "Breck." They also nest on Lakenheath, Stanford and Wangford Warrens, and Thetford, Santon Downham, Wretham and Icklingham Heaths, on Cranberry, Great Hockham, and in the Nar valley near Westacre.

I have prepared a list of the Norfolk and Suffolk heaths on which coast plants, insects, or birds have been found. There are eleven in Norfolk, on 8 of which coast plants have been found, on 5 coast insects, and on 5 the Ringed Plover nests. Of the Suffolk heaths there are 14, and on 13 of these coast plants grow, on 6 coast insects have been found, and on 8 the Ringed Plover has been known to nest. On 5 heaths coast plants, birds, and insects have all been recorded. The following list by showing what is already known on the subject may lead to further discoveries.

NORFOLK.

	Coast Plants.	Coast Insects.	Coast Birds.
Brettenham, Bridgham, Roudham, and Kilverstone Heath	—	†	†
Bromehill, Weeting	†	†	—
Cranberry, Great Hockham	—	—	†
East Wretham Heath	†	†	†
Mill Hill, Merton	†	†	—
Rushford Heath	†	—	—
Santon Warren	†	—	†
Sheepwalk, Thompson	†	†	—
Stanford Warren	—	—	†
Thetford Abbey Heath and Two-mile-bottom Common	†	—	—
West Harling Heath	†	—	—

SUFFOLK.

	Coast Plants.	Coast Insects.	Coast Birds.
Barnham Heath	†	—	†
Culford Heath	†	—	—
Euston Warren	†	—	—
Icklingham Plains	†	†	—
Knettishall Heath	†	—	—
Lakenheath Warren	†	†	†
Session Heath, Brandon	—	†	†
Santon Downham Heath	†	†	†
Thetford Heath (Barnham)	†	—	†
Thetford Warren	†	†	†
Troston Heath	†	—	—
Wangford Warren	†	†	†
Weather Heath, Icklingham	†	—	†
West Stow Heath	†	—	—

The molluscan fauna of the heaths and warrens is very meagre, the only species met with* being *Helicella caperata*, *Helicella virgata*, *Vallonia excentrica*, *Jaminia muscorum*, *Vertigo pygmæa*, and *Pisidium gassiesianum*. *H. virgata* and *J. muscorum* are abundant near the coast, but are equally so on sandy soil in any part of the country. Two species of mollusca are, however, Mr. A. Mayfield informs me, particularly interesting. The prevailing form of the shell of *Jaminia muscorum* on the Suffolk coast is devoid of denticles (var. *edentata*). At Knettishall most of the specimens have two denticles (var. *bigranata*) and at Brandon they are occasionally furnished with three teeth, and are of the form known on the continent as *Jaminia triplicata*, Studer. This is a fairly common continental form, but has only been found in this one locality in England. The other shell worthy of note is a small water-snail, *Planorbis vorticulus*, found as a fossil in the peat of the Little Ouse valley among shells, all others of which still exist in the neighbourhood. The specimens found at Knettishall outnumber those found in all other English deposits. In England —with one exception—it has only been found in the fossil form.†

* 'Journal of Conchology,' vol. ii. No. 11.

† It has been found living at Pevensey, Sussex; in the fossil form in recent deposits at Knettishall, Pleistocene at Grays, Essex; Swanscombe, Kent; and West Withering, Sussex, and in the Cromer Forest Bed at West Runton.

but it still lives on the continent. It is very strange that these two continental forms should thus occur in north-west Suffolk.

But although much of the district is heath, warren or derelict "breck," yet near the villages agricultural operations are carried on with the restrictions imposed by the nature of the soil. There are few records of the crops in years gone by. In 1800 when the Bishop of Norwich prepared for the government a return of the estimated yield of corn per acre in East Anglia, the estimate for Thetford district was the lowest in the Eastern Counties, the number of coombs per acre being 3 to 4½ of wheat, 6 to 8½ of barley, and 7 to 7½ of oats. It is interesting to note that there is a "Hop Ground" two acres in extent, a short distance west of Wretham Hall. Early in the last century such quantities of rye were grown in the district as to gain it the appellation of the "rabbit and rye" country. Professor Newton in 'The Birds of Norfolk' (1866), said the district produced fair wheat, barley of the best quality, and valuable root-crops. Mr. S. J. B. Skertchly said in 1872: "Little cultivation is possible; but the loose sandy soil is occasionally tilled, the rental averaging about 3s. an acre. Rye is the dominant cereal, and 50 years ago was still the staple bread-stuff of the poor. Barley of good quality is grown in places, and lupins have been extensively grown of late years for sheep-feeding. An attempt has been recently made to introduce comfrey, but this plant has hardly had a fair trial. Potatoes of good quality and very free from disease are grown on the poorest sands, but the crops are not heavy. Buckwheat seems to thrive." At the present day most of the fields are of large size, many being as large as farms in the heavy land districts of Norfolk. Yet notwithstanding that the conditions are on the whole unfavourable to agriculture, fairly good crops are sometimes grown, a wet season being naturally much more favourable than a dry. On such an area as Bromehill Warren, except in a rainy season, very little of the corn comes up, and what does survive only grows to about a foot or 18 inches. Nevertheless even here a good deal of land has been broken up in an endeavour to

provide food for game. Of corn crops, rye sown early in the autumn, under ordinary circumstances gives the best crop. In a season like 1907 barley and oats do fairly well, for there is enough moisture and not too much sun, but in a dry season about the middle of July the crops seem to shrivel quite up and become unharvestable. In 1906, when Rushford Heath was first cropped after lying fallow for about 20 years, it yielded a fair crop of rye, and in the following year—which was exceptionally favourable—the yield was 8 coombs of oats and 4¾ coombs of rye per acre. The same year (1907) one of the finest crops of oats grown on the Shadwell estate was that from Elder Hill Heath, which was only broken up 12 months previously, and treated with artificial manures containing large amounts of potash. In the early half of the 19th century it was a general practice to cart a large quantity of marl out of the pits, and "top-dress" the land, but it seems necessary once this has been started, to continue it, for it is found that land which has never been marled will grow better crops than if it had been so treated in days gone by and the practice then discontinued. On some of the Icklingham "brecks" 14 and 15 coombs per acre of barley have been grown, but as a rule 5 coombs per acre is considered a very fair average. Wheat is financially unprofitable. Peas do well in a wet season, as also does mustard, of which a large acreage is sown for sheep feed. Clovers are usually disappointing as they get burnt up or thrown out of the land by frost. When once established lucerne does extremely well, as it is impervious to drought, will give three cuttings a season and last for 6 or 7 years. It will, however, not grow unless there are at least 6 inches of soil above the chalk. Kidney vetch grows very abundantly and produces a heavy crop, while sanfoin does well and makes excellent hay. Lupin is another plant with a tap root which grows well where there is nothing but pure sand, but where there is an admixture of chalk it is a failure. Lupin grows so densely as to be sometimes planted with the part purpose of killing weeds. As there is an almost total want of humus in the soil, mustard and lupins are often ploughed in so as to obtain a proper

heart. Sheep are a great help, of course, but in a dry year it is difficult to grow crops for them to be folded off. In 1907 some 38 acres of the worst land on the Shadwell estate were sown with lupins and a marvellous crop was obtained. Had the summer been a dry one there might not have been a crop at all. Of roots, mangolds do best as they have a tap root, which seeks to go down into the earth thus evading surface drought. Swedes and white turnip are fair crops when the season is moist, but the quality is poor and a large acreage is often sown without any result. The only other crops worthy of mention are buckwheat—locally known as " brank " —and cocksfoot.

In addition to those previously mentioned, I must express my gratitude for help on various points to Mr. Arthur Bennett, F.L.S., and Mr. H. Dixon Hewitt, while valuable assistance has also been given me by the Revs. R. B. Caton and C. Kent, and Messrs. J. C. Blofeld, C. Cockburn, W. A. Dutt, A. N. Forbes, F. W. Harmer, F.G.S., T. Huggan, Claude Morley, F.E.S., A. Stewart, and J. D. B. Whyte.

X.

THE INSECTS OF THE BRECK.

By Claude Morley, F.E.S., &c.

Read 25th February, 1908.

The Breck district of north-west Suffolk and the adjacent part of Norfolk has long been famous for its peculiar insect fauna; but the term is very inappropriate, for there are in reality but few species which are confined to it in Britain and most even of these have been discovered in similar situations upon the Continent. It is not so much the hope of turning up insects which are found nowhere else that attracts the entomologist to this district, as the unusual number of generally rare kinds to be met with within a small area; they are to be found elsewhere, but at long intervals and not associated as is here the case. Commoner kinds too occur in greater profusion than in most districts, probably owing to the dryness of the soil rendering their most deadly enemy, mould, comparatively non-existent; and the mile upon mile of rolling heathland is so far from the "madding crowd" that they suffer little from the routed march of civilization, as represented by the farmer, and in a less degree by the keeper. As far as my memory serves me, there are but four Moths and a single Beetle that have any claim to be considered "peculiar" to the Breck. Foremost of these is *Dianthecia irregularis*, which is widely spread over the country between Bury and Mildenhall but has suffered somewhat severely from the depredations of lepidopterists (now removed) during the last ten years. These used to search for the larvæ and distribute them throughout the country, to the mutual benefit of their stay-at-home friends

and, by exchange, of their own collections. *Agrophila sulphuralis* has occurred singly in several parts of Suffolk, but is now confined to a small portion of the Breck, where it still flourishes. I well remember the glee with which the late Mr. E. G. J. Sparke one day told me that a "dealer" had just asked him where he could find this Moth, and the former had directed him to a spot where it but sparingly occurred, while they had been actually chatting on its head-quarters; "These dealers," he added, with a twinkle, "are not *oculatissimi*"! I have on one or two occasions taken *Lithostege griseata* at Brandon, attracted by artificial light at night, but have no idea of its frequency or distribution, except that it is "confined to the Breck." The handsome *Spilodes sticticalis* and small *Tinea imella* are equally limited in their range, though I do not consider they have bred from generation to generation here, as Mr. Clarke would have us believe; like the late Professor Westwood. I am by no means a staunch evolutionist in the generally accepted sense of the term, but I certainly believe considerable changes in our insect-fauna have taken place since the post-glacial period. The single Coleopteron peculiar to Brandon is *Diastictus vulneratus* which was first discovered to be a British species by me in June, 1902, when I found one specimen beneath rabbits' exuviæ. In May of the following year, the late Mr. A. J. Chitty, M.A., F.E.S., and I both took a specimen as far as we could reach down the holes of rabbits at the same spot, and finally early in the same month last year he took the fourth specimen in a similar manner. This species has a somewhat extended Continental range, appears to be nowhere common, and has been found in similar high, sandy situations in the vicinity of Lyons.

The insect-fauna of secondary importance comprises those species *attached* to an arenaceous soil wherever it crops out. A great many of these are common on all the sandhills of our coasts, especially at Deal and Felixstowe; the very much wider extent of their pabulum in the Breck renders their propagation more profuse and certain, for here there is no danger of being blown either out to sea or across the cultivated

lands away from it. Of these I have made out a list of eighty species of Beetles all taken by myself in the Breck; their number will show how analogous must be these inland sands with those of the shore, and suggests that for such species as *Amara fulva* (which also is found on the Crag-sands at Foxhall, in south-east Suffolk), *Hypera fasciculata* on *Erodium cicutarium*, *Crypticus quisquilius*, *Harpalus anxius* and *H. picipennis* there must be a great deal of natural salinity still exhaled by this necromantic tract of country. The last named beetle was first here found inland in Britain (*cf.* Entomologists' Monthly Mag., 1807, p. 9), but recently Mr. Holland has found it on a much older formation—the Lower Calcareous Grit which is also sandy, intersected by thick calcareous lands containing rounded nodules, belonging to the Oxfordian Oolite group. Several very local Hemiptera are also to be found on the open Breck, where *Verlusia rhombea*, *Pseudophlæus Fallenii* and *Systellonotus triguttatus* are frequent in August, with *Asiraca clavicornis* and the usually coast-frequenting *Orthotylus rubidus*, var. *Moncreaffi*.

Yet a third group of species is everywhere to be found here, though very rarely on the coast: those exclusively attached to heath country, either on account of its peculiar flora or in connection with the animals which alone there find scope for their wild habits. Among these may be enumerated *Geotrupes typhæus*, *Psammobius sulcicollis*, *Byrrhus dorsalis* and *B. murinus*. *Onthophilus sulcatus* and *Orthocerus muticus*, belonging to the latter; and *Trachyphlæus scabriculus*, *Hydnobius punctatissimus*, *Mecinus circulatus*, &c., to the former. Probably this common attraction for such usually diverse insects accounts for the number of rare things met with, a large proportion of which, more especially among the phytophagous heath-dwellers, such as *Agrotis valligera* and *Euplexia cuspidata* so closely resemble their surroundings as to frequently defy detection, which is most difficult in the case of *Gronops lunatus*.

No notes on Breck insects can be complete without some passing mention of the many rare denizens of the marshes which intersect it. The most prolific of these are probably

at Tuddenham, Brandon, and Barton Mills. Here still linger in numbers such truly fen insects as *Tropidia scita*, *Lipara lucens*, *Acompus rufipes*, *Liburnia speciosa*, *Tettix subulatus*, *Prosopis Kriechbaumeri*, *Silis ruficollis* and *Delphax pulchellus*, as well as *Acœnitus arator*, which has been taken elsewhere in Britain, only in Wicken Fen by Mr. Chitty. And it is in these boggy places that the evolution of this district is most apparent; even in so short a period as the past ten years I am quite easily able to note, both along the Little Ouse and the Lark, numberless spots upon which it was perilous to venture formerly and throughout which one may now wander dryshod. If so great a change has taken place in a single decade, it is not difficult to think back to the condition of the country side a century or so ago, and thence to the peculiarly strategic position which hoary Icklingham once held.

(N.B.—The following list is drawn almost exclusively from my own diaries and cannot, consequently, be considered the respective productions of the various localities, since I have paid far more attention to a few than to others of, probably, equal prolificness. The Coleoptera and Hemiptera are very fairly represented; but the Lepidoptera are poor, as I am unfortunately unable to raise more than a superficial interest in so well worked an Order.)

WITHIN TWO MILES OF BRANDON.

Broscus cephalotes. Generally distributed throughout the Breck sands.

Trachyphlœus scabriculus. Very abundant on the open Breck, among Moss, &c.

Cleonus sulcirostris. Not common in sand hollows on heaths.

Hydnobius punctatissimus. Once swept from Ling on Session Heath, in 1896.

Sitones griseus. Not uncommon beneath small stones on open Breck.

Lithostege griseata. Taken at light in Brandon.

Trox scaber. Often very abundant at Town Street, Brandon, sometimes flying by day.

PHYLLOBIUS VIRIDICOLLIS. Frequently swept from hedge-bottoms.

AMARA FULVA. Uncommon, burrowing in the sand on heaths, beneath small stones.

HYPERA FASCICULATA. Local, and always beneath *Erodium cicutarium*.

PSEUDOPHILŒUS FALLENII. Local, and always with the last species.

GEOTRUPES TYPHŒUS. In dung and flying at dusk.

SIMULIUM REPTANS. "The Sand Fly"—a perfect pest throughout the district.

GELECHIA TERRELLA. Probably common; taken on open sand of Breck.

GELECHIA ANTHYLLIDELLA and G. EXPOLITELLA. With the last.

CRYPTICUS QUISQUILIUS. A common sea-coast species, widely distributed here.

ORTHOTYLUS RUBIDUS, var. MONCREAFFI. A common coast Hemipteron, beneath *Erodium*, Brandon.

ASIRACA CLAVICORNIS. Common on short herbage in sandy places.

DIASTICTUS VULNERATUS. The only four known British specimens of this Beetle have been taken in a radius of a few yards by Mr. Chitty and myself.

SYSTELLONOTUS TRIGUTTATUS. Uncommon beneath *Erodium*, unassociating with Ants. Brandon.

VERLUSIA RHOMBEA. Not common, a few specimens at Brandon in August.

BYRRHUS MURINUS. Not uncommon amongst rabbits' exuviæ on open Breck; hard to detect.

HARPALUS PICIPENNIS and H. DISCOIDEUS. Taken singly throughout the district.

ONTHOPHILUS SULCATUS. Local and not very common, a arms' length down rabbits' holes.

ORTHOCERUS MUTICUS. Not uncommon beneath small stones and crawling on open Breck.

APHODIUS ARENARIUS and A. TRISTIS. Both occur with the *Onthophili* (supra)

EUPELIX CUSPIDATA. Apparently rare but difficult to detect on the open Breck.

CARDIOPHORUS ASELLUS. Very common, both crawling and under stones on open Breck.

CORYMBETES ÆNEUS. Very rare ; the second Suffolk specimen was found under a stone, on the Breck by Mr. Elliott in April, 1904.

THETFORD WARREN.

CALATHUS FUSCUS and C. FLAVIPES. Both usually coast species.

NOTOXUS MONOCEROS. A common species throughout the Breck and often entirely black.

LICINUS DEPRESSUS. A single specimen in 1896 found crawling on the road.

PSAMMOBIUS SULCICOLLIS. The only specimen I ever took ; under stone, near Warren Lodge.

ERISWELL ON MAIN ROAD.

VERLUSIA RHOMBEA. Several by sweeping long, dead grass ; probably sparingly everywhere.

METACANTHUS PUNCTICEPS. Another coast species, not rare here on *Ononis spinosa*.

LAKENHEATH WARREN.

GEOTRUPES TYPHÆUS. Probably occurs throughout the Breck.

AMARA CONSULARIS, A. FULVA, and A. TIBIALIS. A few of each beneath stones occasionally.

HARPALUS ANXIUS and H. PICIPENNIS. Both not rare beneath stones ; both coast species.

CLEONUS SULCIROSTRIS. Common at Maidcross Hill.

SITONES GRISEUS. Sparingly.

MECINUS CIRCULATUS. At Maidcross Hill, rare.

HETEROGASTER URTICÆ. Very abundant on Nettles ; confined to sandy places.

NOTOXUS MONOCERUS.

Rhinoncus castor. Abundant throughout the whole Breck district, often on bare sand.

Licinus depressus. A single one here, as at Thetford Warren.

Apion fuscirostre. Common though local, on *Ulex europæus*.

Broscus cephalotes. Common in sand pits, &c.

Calathus flavipes.

Byrrhus dorsalis. Burrowing in sand beneath stones, rare.

Cryptícus quisquilius.

Agrotis valligera. Several times taken by day, sheltering beneath stones in the open breck.

BARNHAM STATION.

Amara consularis. Rare, a coast species and hardly taken elsewhere inland.

DOWNHAM.

Apion fuscirostre and Sitones griseus.

ICKLINGHAM PLAINS

Philopedon geminatus. One of the commonest beetles throughout the whole Breck district.

Hypera fasciculata. As usual, beneath *Erodium cicutarium*

Cryptícus quisquilius and Gelechia diffinis.

WORDWELL.

Harpalus anxius and picipennis and Byrrhus murinus.

BARTON MILLS AND ELVEDON.

Microzoum tibiale. Common: first taken here in England, by Rev. W. Kirby, in 1797.

TUDDENHAM.

Agrophila sulphuralis and Spilodes sticticalis.

ACULEATA ONLY FOUND ON THE BRECK AS REGARDS SUFFOLK.

Pompilus bicolor. P. unicolor, and P. minutulus.

Tachytes unicolor. Oxybelus mucronatus.

Colletes marginata. Bombus Smithianus. All these were taken by Dr. Perkins.

MOTHS CONFINED TO THE BRECK.

Dianthecia irregularis.
Agrophila sulphuralis.
Lithostege griseata.
Spilodes sticticalis.
Tinea imella, &c.

MOTHS CONFINED TO THE BRECK AS REGARDS SUFFOLK.

Agrotis præcox and A. ravida.
Acontia luctuosa.
Eupithecia consignaria.
Acidalia rubricata, &c.

There are a very great many species of all orders of insects which occur in the marshes and fens between the rolling Breck uplands, which are either universally rare or especially peculiar to the district, though many of the latter are clearly survivals of the time when this part of the country was more closely connected with the Fens than it now is; a long list could be made of those which alone occur here in the county of Suffolk.

XI.

METEOROLOGICAL NOTES, 1907.

(From observations taken at Norwich.)

By Arthur W. Preston, F.R. Met. Soc.

Read 25th February, 1908.

January.

The barometer was above 30 ins. continuously from 8 a.m. on January 4th to 2 a.m. on the 28th, or a period of just 24 days. On the 23rd it reached 30.90 ins., which was the highest reading recorded here since the 9th January, 1896. The first half of the month was mild, and the last half cold. On the 27th the sheltered thermometer fell to 14.8 degrees, and that on the grass to 11 degrees, and on the 23rd and 24th it did not exceed 29 degrees and 27.4 degrees respectively in the day-time. The snow of the previous Boxing Day lay on the ground until the 7th, and during the last week snow again fell almost daily. Great fogs occurred on the 18th and 19th. On the whole it was the most winterly January since 1897.

February.

Winter continued to reign during the first half of the month, during which time the ground was covered with a mantle of snow. The lowest temperature recorded was 20.6 degrees, in the screen on the 8th, and 18.2 degrees on the grass on the same day, but although no very exceptionally severe frosts occurred, the continued low day temperatures made the winter appear long and monotonous. The thermometer did not reach 50 degrees once between December

4th and February 16th, a period of 73 days, a circumstance which had not occurred for twelve years. A sudden depression of the barometer on the 19th, when the mercury fell to 28.27 ins., brought a violent gale from the W.N.W., and was attended by disasters at sea, the most serious of which was the wreck of the SS. Berlin at the Hook of Holland on the early morning of the 21st, attended with an appalling loss of life. Further snow fell in the last week, and the mean temperature of the month was lower than that of any February since 1902.

March.

Cyclonic disturbances caused great fluctuations of the barometer during the second and third weeks, during which time the weather was very changeable, with snow on the 5th, 10th, and 11th. Gales and strong winds prevailed on the 18th, 19th, and 20th. A remarkable change set in on the 20th, and the remainder of the month was rainless and nearly cloudless, with an abnormally high temperature on many days. In March, 1906, a temperature of 67 degrees was registered on the 7th, which was the earliest date of so high a reading for eighty years past. In 1907 the highest March temperature for seventy-seven years was recorded, viz., 70 degrees on the 30th. The brilliant and warm weather fortunately extended over the Easter holidays, which, although a "March Easter," even outstripped the fine weather of the previous Easter, when the festival occurred in the middle of April. The mean temperature of the month was 3 degrees above the average, and the continuous sunshine at the close of the month rapidly transformed the appearance of the country and forced on the fruit blossoms and garden flowers.

April.

The fine weather with which March closed lasted till the 3rd April, although an ominously falling barometer threatened a break-up at an earlier date. But it is a remarkable fact that when once a break-up did take place it was in earnest

and it was not until September that any really continued fine settled weather again prevailed. April was an exceedingly wet, unsettled month, the rainfall being more than double the average, and was accompanied by chilling winds and low temperature. Between the 6th and 23rd the temperature did not once touch 60 degrees, and frost occurred on eleven nights.

May.

During the first fortnight the temperature was high for the season, and on the 11th the thermometer reached 80 degrees in the shade, which appears to be the earliest "eighty" recorded in this neighbourhood since 1867, and, as it transpired in the sequel, this 11th May was not only the warmest day of May, but of the entire year. It is but rarely that the greatest heat of the year occurs in May, but the same occurrence happened in 1862 and 1892, although in the last-named year it was much later in the month. During the middle and latter part of the month the weather was very unsettled, with a great preponderance of cloud and gloom, with saturating rains and chilling winds. A sharp thunderstorm occurred on the afternoon of the 8th, and distant thunder was heard on some other days. The total rainfall of the month was about an inch above the average, and between the 13th and 31st there were only two days on which rain was not measured.

June.

This was a cold, cloudy and wet month, in fact not since 1879 has so ungenial and unseasonable a June been recorded in this neighbourhood. On only one day did the thermometer exceed 70 degrees, and the skies seemed to be continually dripping. The total rainfall for the month, however, was only .82 ins. above the normal, but the large preponderance of cloud, the strong, gusty winds, and the frequent falls of rain in small quantities took away all semblance of summer, and it was a dreary and depressing period. The only warm day (the 9th) was succeeded in the evening by a sharp thunderstorm, and another slight similar storm on the 29th was the

last recorded here during the year, although other parts of England were visited by severe electrical disturbances on several dates later in the summer.

July.

This was the coldest, cloudiest, and most unseasonable July since 1888, although not nearly so wet as in that year. Both the mean temperature and the maximum day temperature for the month were the lowest for July on our records. Not once did the thermometer touch 70 degrees between June 9th and July 15th. During the third week (whilst very warm weather was prevailing in the West of England) conditions became temporarily anticyclonic, but the temperature here kept low, and there was considerable cloud on several days. Rough winds frequently prevailed, and fruits were late in ripening, and nearly all the summer garden flowers came into bloom much behind their usual time. Corn was late in maturing, and generally the outlook was unfavourable. The total amount of rainfall for the month, however, was an inch deficient, and the mean temperature was 4.5 below the average.

August.

In the opening days of the month the thermometer rose to a higher degree than had been noted since the second week of May, and although no great summer heat was recorded, there were more warm days than in July. There were some cold nights at times, and mean temperature was 1.2 degrees below the average, but the month was a decided improvement on July, though a continued frequency of cloud caused an unusual absence of sunshine, and kept down the temperature. Rain fell on sixteen days, but the total fell short of the average by nearly an inch. Wheat harvest commenced about the 22nd, fortunately just at the time when the weather, which had been unsettled for so many weeks, began to take a turn for the better. The hottest day was the 4th (max. 77.4 degrees) which was 14 degrees lower than the hottest day of the previous August.

September.

From the 6th to the 24th anticyclonic conditions prevailed, and the month was exceedingly fine throughout, forming a pleasant contrast to each of the previous five months, giving the farmer an opportunity of getting in the harvest in a phenomenally short space of time, and those who had postponed their summer holidays to September were exceptionally favoured. A very singular drop in temperature occurred on the 3rd, when the thermometer failed to exceed 53.2 degrees all day, and this is the more noteworthy, as it was the anniversary of the extraordinary reading of 93 degrees which happened on the same day of the previous year, thus illustrating that it is possible for one day to be 40 degrees warmer in one year than it is in the next. The month was the driest September since 1898, the total rainfall having been but half an inch. Mean temperature was 0.3 higher than that of July. On the 25th the thermometer went up to 79 degrees, which was the highest recorded since May 12th, but on the nights of the 22nd and 23rd there were some rather sharp ground frosts.

October.

This month was inclined to be rainy in the early part, but it was, on the whole, a fine pleasant period of good autumnal weather, with many mild days and but little cold. The thermometer exceeded 60 degrees on nine days. The total rainfall amounted to 3.26 ins. Winds were generally from a southerly quarter, and light in force, there having been a remarkable absence of the gales which are usually associated with this season of the year.

November.

The weather of this month was normal in most of its features. Owing to the absence of wind there was a tendency to fog on many days, and there was a good deal of drizzling rain and much cloud. Rain fell on 24 days, but nearly

two-thirds of the month's total fell between the 22nd and the end, which period was exceedingly rainy. On the 26th .68 ins. fell, being the heaviest fall since April. There was no snow. A sharp gale from N.W. sprang up in the early hours of the 13th, and a sudden squall occurred about noon on the 26th, accompanied by great darkness.

December.

The south-westerly type of weather continued till Christmas, and a great deal of rain fell. On the 14th the barometer fell to 28.50 ins., which was the lowest reading recorded here since the 24th February, 1900. Following the depression was a rise of the barometer of unusual rapidity, the mercury ascending 1.64 ins. in 33 hours. During the last week freezing winds from the E. prevailed, drying up the roads, and were accompanied by slight snow and sleet on three days. There was a good deal of cloud on many days, but not so much fog as is usual in December.

The Seasons.

The following tables show the mean temperature and rainfall of the four seasons, together with those of the five previous years, compared with the usual averages. Winter comprises the three months December to February inclusive; Spring, March to May; Summer, June to August; and Autumn, September to November.

TEMPERATURE.

Seasons.	1902.	1903.	1904.	1905.	1906.	1907.	Average	Departure of 1907 from average.
	degrees.	degrees.	degrees.	degrees.	degrees.	degrees.	degrees.	degrees.
Winter ...	37.9	41.8	38.3	39.2	39.3	36.2	38.0	− 1.8
Spring ...	46.3	47.3	47.8	47.5	46.7	47.6	46.3	+ 1.3
Summer ...	58.7	58.7	60.8	62.1	61.1	57.8	60.3	2.5
Autumn ..	50.1	51.2	49.8	47.5	52.9	50.7	50.2	+ 0.5
Year ...	48.4	49.5	49.3	49.0	49.7	48.4	48.7	0.3

RAINFALL.

Seasons.	1902.	1903.	1904.	1905.	1906.	1907.	Average	Departure of 1907 from average.
	in.	in.	in.	in.	in.	in.	in.	in.
Winter ...	6.09	3.64	5.96	4.91	7.73	6.09	5.37	+0.72
Spring ...	6.77	5.83	4.50	5.29	5.32	7.77	5.13	+2.64
Summer ...	7.82	10.54	4.70	6.05	4.96	5.74	6.87	-1.13
Autumn ...	4.14	9.77	4.98	8.11	8.75	6.57	8.38	-1.81
Year ...	22.30	29.44	21.50	22.06	28.54	26.25	25.75	-0.50

It will thus be seen that the winter months gave a mean temperature of nearly two degrees under the average, being the lowest recorded since 1895. The spring was warmer than usual, but the summer was two and a half degrees colder than the normal, and we have to go back to 1888 for as cold a summer season. The temperature of the autumn was slightly over the average, but lower than that of the previous year. The winter gave an excess of rain amounting to about three-quarters of an inch, but the spring was exceptionally wet, the amount registered being about half as much again as the normal fall, and it was the wettest spring season since 1872. The summer rains, though frequent, failed to reach the average amount by upwards of an inch, notwithstanding the popular belief to the contrary, and the autumn was also drier than usual, the deficiency amounting to nearly two inches.

The Year.

The mean temperature of March, May, October, November and December was in each case above the average, the greatest departure having been in March, which was 3 degrees in excess. All the other months were equal to or below the normal temperature, July showing a deficiency of as much as 4.5 degrees. The coldest night of the year was that of January 26th-27th, when the thermometer fell to 14.8 degrees in the screen and to 11 degrees in the open. The warmest day was May 11th, when the temperature rose to 80 degrees in the

shade, which was the only occasion during the year on which 80 degrees was reached. The wettest month was April, with 3.65 ins. of rain, and the driest was September with only .52 ins. The total rainfall of the year (26.25 ins.) was less than that of 1906, but the number of days on which rain (or snow) was measured exceeded that of any on our records, the next highest being 1900, with 222 days. The total number recorded (231) was 40 days above the average. No excessive fall occurred on one day, the heaviest having been .74 ins. on April 30th, against 1.05 ins. in both 1905 and 1906. The foregoing figures show that 1907 attained its rainy reputation not from the excess of rain, but from the unusually large number of days on which it fell. The total rainfall for the year only exceeded the mean by half an inch, although by the end of June the total of the first six months had been as much as 3.51 ins. above the normal. July, August, September, and October all gave a deficient rainfall, resulting, notwithstanding that November and December were wet, in the second half of the year being considerably drier than the average; in fact the rainfall of the first half exceeded that of the second half, whereas in a normal season the second half should exceed the first half by $5\frac{1}{2}$ inches. A notable feature of the year was a remarkable absence of thunderstorms, there being practically none at the time when they usually attain their greatest frequency and intensity. The low temperature and excess of days with rain, following on a winter of greater severity than any since 1895 (broken only by a brief period of real summer weather at the end of March), made the weather of the year appear exceptionally bad and ungenial, and the great preponderance of cloud and absence of sunshine during the summer resulted in flowers and fruits being much behind their usual times of flowering and ripening. The fruit crop, though late, was an exceedingly fine one.

1907.

Month.	Barometer. Highest.	Date.	Lowest.	Date.	Mean.	Thermometer. Highest.	Date.	Lowest.	Date.	Mean.	Hygrometer. Mean Relative Humidity. 9 a.m.	Cloud. Estimated Proportion	Rainfall. Inches.	No. of Days.	Wind. Direction. N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Mean estimated force
	in.		in.		in.	°		°		°	/												
Jan.	30.90	23	29.03	2	30.265	48.8	12	14.8	27	36.8	90	6.5	1.58	18	2	0	2	3	1	2	15	6	3.3
Feb.	30.57	2, 28	28.87	20	29.964	54.4	28	20.6	8	36.4	84	7.3	1.68	22	2	3	2	1	3	4	3	10	3.1
March	30.51	27	29.46	18	30.128	70.0	30	26.8	5	43.9	75	4.2	1.42	13	1	0	4	1	6	4	5	10	3.1
April	30.28	24	29.28	3, 6	29.767	67.4	24	29.4	20	46.3	79	6 7	3.65	22	4	1	7	1	5	1	5	6	3.2
May	30.23	29	29.28	3	29.863	80.0	11	33.8	21	52.4	70	7.0	2.70	22	3	3	4	4	7	0	5	5	3.3
June	30.12	17	29.43	1	29.829	73.8	9	44.0	7	56.6	75	7.8	2.73	21	0	1	1	0	5	13	9	1	3.5
July	30.42	16	29.61	4	30 025	73.2	29	40.2	23	56.9	69	7.3	1.72	15	3	7	2	1	2	6	7	3	3.1
Aug.	30.28	22	29.58	15	29.955	77.4	4	43.0	24	59.8	71	6.9	1.29	16	0	2	1	1	0	9	13	5	3.2
Sept.	30.50	9	29.55	2	30.125	79.0	25	32.6	23	57.2	80	4.4	.52	10	2	3	8	3	7	2	1	4	2.1
Oct.	30.03	12	29.18	14	29.663	65.4	1	33.6	25	50.8	91	7.0	3.26	23	1	1	3	4	11	5	4	2	2.7
Nov.	30.43	30	29.22	26	29.664	57.6	9	28.0	20	44.1	94	7.5	2.79	24	5	0	4	7	4	1	2	7	2.5
Dec.	30.35	17	28.55	14	29.747	56.4	8	26.2	16	40.0	92	7.0	2.91	25	1	0	9	0	4	10	6	1	3.4
Means					29.941					48.4	81	6.6											3.0
Extremes & Totals.	30.90	Jan. 23rd	28.55	Dec. 14th.		80.0	May 11th.	14.8	Jan 27th.				26.25	231	24	21	47	26	55	57	75	60	

XII.

SOME ADDITIONS TO THE NORWICH CASTLE-MUSEUM IN 1907.

By Frank Leney.

Read 31st March, 1908.

The African Antelopes previously mentioned in these notes as presented by Mr. Edward North Buxton have been mounted and grouped by Messrs. Rowland Ward, Ltd., in a large glazed case and form a remarkably effective exhibit in the Animal Room. The cost of the case and the charges for mounting and grouping the animals as in their natural habitat was generously defrayed by Mr. Geoffrey Fowell Buxton and a few local friends. Mr. E. N. Buxton has added to his "game trophies" in the Museum collection, mounted heads and horns of the White-bearded Knu (*Connochætes taurinus albojubatus*), Waller's Gazelle (*Lithocranius walleri*), and two Beisa Antelopes (*Oryx beisa*) from East Africa; Rocky Mountain Goat (*Haploceros montanus*); Big Horn Sheep (*Ovis canadensis*) from the Rocky Mountains; Wapiti (*Cervus canadensis*) from Wyoming, North America; and Mouflon (*Ovis musimon*) from Sardinia; skull and antlers of Carpathian Maral (*Cervus maral*) from Galicia; and antlers of Red Deer (*Cervus elaphus*) from Asia Minor and a peat bog in Ireland. A well mounted head of a Red Deer (*Cervus elaphus*) from Perthshire was presented by Mr. Eustace Gurney. An adult male Orang utan (*Simia satyrus*), presented by Dr. Chas. Hose of Sarawak, Borneo, has been mounted and placed on a "nest" or seat on a branch of a tree. Dr. Hose very kindly obtained a nest constructed by an Orang and native foliage so that the exhibit might be a correct representation of the habitat of these remarkable man-like apes.

The ornithological collection has been augmented by an important donation of 92 birds' skins, including 65 species, collected by the donor, Captain Richard Crawshay of Leighton Buzzard, during a six months' visit to the Island of Tierra del Fuego, off the coast of Patagonia. Capt. Crawshay is the author of 'The Birds of Tierra del Fuego,' recently published by Quaritch of London. This work contains a description of the above mentioned collection with twenty coloured illustrations of species which have been mounted, including the very rare and beautiful Magellan Plover (*Pluvianellus sociabilis*). It may be mentioned as showing the completeness of our collection of Raptorial Birds that for eighteen consecutive years Mr. J. H. Gurney has been able to record in these Transactions the acquisition of desirable additions to the famous Gurney Collection of Birds of Prey, but during 1907 the opportunity did not occur of obtaining any desiderata. Mr. Gurney, however, was able to add to the collection two nestling Jackal-Buzzards, bred for the first time in England, in his Aviary at Keswick Hall. Mr. W. H. M. Andrews presented five skins of Birds of Prey from Victoria, Australia, including a fine specimen of the Wedge-tailed Eagle (*Uroaetus audax*).

The collection of Birds' Eggs and Nests has received many interesting additions including a collection of South African Birds' Eggs, representing 46 species, localised and dated, presented by Major R. Sparrow; egg of Lyre Bird (*Menura victoriæ*) from Victoria, Australia, presented by Mr. W. H. M. Andrews; and a nest of the Common Wren (*Troglodytes parvulus*), built in a nesting box at Thorpe St. Andrew, Norwich, July, 1907, presented by Major W. S. Dods.

Mr. R. A. Todd of the Marine Laboratory Lowestoft, kindly supplied specimens of Hyas aranens from Lynn Deep; Purple Sun-Star (*Solaster endeca*) from Hartlepool; Common Cross-fish (*Asterias rubens*) from Flamborough, and Knotty Cushion Star (*Hippasterias phrygiana*) from the Dogger Bank.

Commander Shopland, R.I.M., gave a collection of shells, including 200 species, specifically determined, collected principally at Aden.

The section of Economic Biology has been augmented by the purchase of twenty glass jars containing specimens illustrating the Life-history of the Cockchafer Beetle (*Melolontha vulgaris*), and the Golden Chafer (*Cetonia aurata*) in one jar: and models of three species of mushrooms, *Agaricus campestris*, *A. phalloides*, and *A. pantherinus*, the latter presented by the Norwich Museum Association.

A number of examples of typical Rocks have been acquired for the purpose of forming a collection illustrative of the study of Petrology. Typewritten descriptive labels are being placed with each group of rocks and smaller labels with each specimen pointing out its characteristics as well as giving the name and locality. The labels are based on L. Fletcher's 'Introduction to the Study of Rocks' (British Museum Guide), and F. Rutler's 'Study of Rocks' (1904).

An interesting addition to the collections in the Keep illustrating the history of man in early times, is a series of South African Stone Implements collected and presented by Colonel Feilden, C.B. A number of the specimens are roughly fashioned weapons of Cape Sandstone taken out of a brick-earth deposit at Stellenbosch, indicating a very remote period; others are "Kitchen-middens" from the Cape Flats and Table Bay, representative of a stone-using people who were actually in touch with civilization as represented by the first Dutch settlers in South Africa.

The total number of visitors to the Museum was 111,509 during the twelve months ending December 31st 1907.

XIII.

NOTES ON THE HERRING FISHERY OF 1907.

By T. J. Wigg.

Read 31st March, 1908.

The results of the Herring Fishery of 1907 are very surprising. The net catch exceeded that of 1902, which up to the present was regarded as the record year. The last season, however, has seen that record beaten and the enormous quantity of 52,122 lasts was registered at Yarmouth, and 39,107 lasts at Lowestoft, as the year's catch.

This does not represent the whole number of Herrings taken, as many of the boats, on that memorable Tuesday, October 22nd, were obliged to throw the whole of their catch overboard owing to the fact that room at the quay side could not be found for all the boats. A large quantity of Herrings were also condemned as unfit for food, and were sent off to the Corporation refuse destructor to be consumed.

The Scotch boats began to arrive at Yarmouth during the first days of October, and trains bringing large contingents of Scottish curers and their following of coopers, carters and gutting girls were arriving at Yarmouth almost daily, until it was estimated that, with fishermen and shore hands, the Scottish colony at Yarmouth added something like 10,000 to the normal population for about three months.

Taking into consideration the enormous catch on the east coast of Scotland during the early summer, it was anticipated by many persons that the East Anglian fishery would be somewhat of a failure, either in the amount of the catch, or, if there should be a good fishing, a glut of the continental markets would assuredly follow, and in consequence the prices of the herrings would greatly depreciate. Subsequent events proved the fallacy of this statement.

Tuesday, October 22nd, was a never-to-be-forgotten day in the history of the East Anglian Herring Fishery. On that day the catch brought into Yarmouth harbour beat all records. The fishing fleet on Monday struck Herrings in vast numbers, and the catches ranged from 200 crans downward. They were sold for what they would fetch—from 5s. to 6s. a cran, and in some cases at a much lower figure. In fact it was a difficult matter in many cases to get rid of them at all. Many a waggon load was taken into the Flegg district to be used as manure. It is almost impossible to attempt to describe the appearance of the harbour and quay on this particular day. Boats were everywhere from the Southtown Bridge to the mouth of the river. Swills, barrels, baskets, and carts covered the quay beside the river, and everybody connected with the fishing was working "for all he was worth," to get rid of the enormous catch.

"More room," was the cry, and the Corporation will do what they can to give a good answer. A new Dock scheme is now before the Council by which extra space will be allotted to the boats which frequent this port for the Herring harvest.

"The abnormal catch of Herring of the past week has brought to our port an experience which has never been known before since Herrings have been caught off Yarmouth. The glut, with all the waste which necessarily attended it, was more than even skilful organization could cope with; and for the first time boats had to go just outside the harbour, to the Ham, to throw overboard their catches. This was the experience of some twenty-five boats. Such a course was, naturally, a most disappointing result of much labour. One boat, for instance, came into harbour at about eight in the morning, and, because of the crush of boats at the quays, waited until nearly midnight without being able to land her Herrings, and in disgust or despair, went out to sea and threw her load overboard. There were Herrings being landed from the Town Hall to even below the Ballast Wharf. On the Gorleston side of the river the river-steamers' slipway was utilised for landing Herrings for the new pickling-plots there.

As an example of the impossibility of coping with the influx of fish, it may be stated that some purchasers of fish could not obtain horses or carts until the next day, and so suffered much loss in the deterioration of fish. And as an illustration of the wealth of Herrings which were found upon the fishing ground, one boat with only a portion of its nets left, to the extent of seven nets, secured about ten lasts of Herrings. If you work out the sum you will find that that meant about a Herring for every mesh of the nets! Another feature of the experience of last Tuesday and Wednesday, was the unexampled scene of agricultural wagons brought upon the Fishwharf to take away the fish bought for manure, and the huge horses, compared with those generally employed in the carting of fish, champing their bits, and neighing in their unaccustomed surroundings, standing up to the eaves of the roof. But the saddest part of all the experience was the necessity for the intervention of the Commissioners, who on Wednesday took out some sixty tons of fish, properly disinfected, in their hopper barges for consignment to the deep sea."—*Yarmouth Independent*, 26th October, 1907.

The export of Herrings during the month of October reached the height of its activity, and steamers were daily leaving the harbour loaded with salt pickled fish for the North and other parts of the Continent. The wonder is that, with so much pressure upon all the resources of accommodation in our harbour, berths can be so readily found for these steamers to load. Every inch of quay space has been utilised, and as soon as one boat has filled her hold and taken her deck cargo, she is cleared out and another steamer hurried into the vacant berth. As an example of the business done in this direction, it may be mentioned that within a week in October, no fewer than seventeen steamers left Yarmouth with cured Herrings, in addition to those which left the port with fresh Herrings in ice.

The catch mentioned above exceeded all records at Yarmouth, except that of Tuesday, November 11th, 1902, when upwards of 45,000 crans were brought ashore and sold at fair prices. The actual catch landed on Tuesday, October 22nd, was 43,320 crans.

At Lowestoft also, the catch created a record for the port, the estimated number being 37,730 crans. These figures show a total of 81,050 crans, that is, approximately, 8,105 lasts, making a total in round numbers of 106,986,000 fish ! !

Prices at both Yarmouth and Lowestoft varied, the highest being six shillings per cran, and the lowest two and sixpence. Quality generally was very poor. A number of skippers failed to find a market for their fresh fish and returned to sea with them, some going as far as Grimsby to effect a sale.

Although the season has beaten all previous record in the number of Herrings landed the cash value for fresh fish is probably less than that of the smaller quantity caught last year, and quite a number of individual fishermen and owners must have found the current prices less profitable. However, we must content ourselves with the thought that a big fishing produces " the greatest happiness to the greatest number." It means more employment and more wages to more hands.

In conclusion, I extract the following from the Fish Trades Gazette for November 23rd, 1907, with the hope that it may prove of interest to any one who may read these notes :—

" One or two points of difference between the Scotch and East Anglian fishings may be worth noticing. In the Moray Firth and along the east coast of Scotland generally, rough, dark nights are always the best for fishing, but on the Norfolk and Suffolk coasts the best results are usually obtained on clear moonlight nights. Then on the Scotch coasts the Herrings appear to have deserted their old haunts on the inshore grounds and fishermen have had to go farther and farther to seaward for them every year—often 80 to 100 miles or more. The English fishing, on the other hand, is got in a comparatively small area, and usually on the same ground year after year. The fishing generally starts to the north of Yarmouth, and draws southwards as the season advances ; but occasionally this order is reversed.

" To judge by the enormous quantities landed at Yarmouth and Lowestoft in a good season, the number of herrings congregated on the small fishing area must be incalculable. . . . . " To deal with the Herrings, a larger staff of workers is required than on the Scotch coast. The landing

frontage is very extensive, especially at Yarmouth, and this necessitates more men to attend to the discharging of the Herrings. Then, on account of the keen demand for Herrings for the fresh markets, prices are often so high that curers are compelled to stop buying for days, perhaps for weeks. When therefore a big supply brings prices down to a figure that they can afford to pay, curers must be prepared to buy a large quantity, in order to make up for lost time, and this means the employment of a greater number of women than would be considered necessary at a Scotch station. . . . .

"Russia provides the great outlet for the Herrings cured at Yarmouth and Lowestoft. In the German markets the Dutch are successfully maintaining their long-standing connection, and as they are generally prepared to accept lower rates than the British, the latter have found it more profitable to exploit the Russian Markets."

With their usual courtesy, Mr. W. L. Smith, the Borough Accountant of Yarmouth, and Mr. H. J. Henderson, the Harbour Master of Lowestoft, have furnished me with the following figures :—

RETURNS OF HERRINGS LANDED AT YARMOUTH IN 1907.

Month.	Lasts.	Month.	Lasts.
January . .	—	Brought forward	257
February .	—	July . .	133
March . .	2	August . .	989
April . .	40	September .	1,330
May . .	58	October . .	22,541
June . .	157	November .	23,404
		December .	3,468
Carried forward	257	Total .	52,122

Number of Yarmouth boats employed, about . . 220
,, Scotch and other boats employed, about 720

RETURN OF HERRINGS LANDED AT LOWESTOFT IN 1907.

Month.	Lasts.	Month.	Lasts.
January . .	—	Brought forward	1,277
February .	—	July . .	37
March .	34	August . .	28
April .	970	September .	75
May . .	100	October . .	15,602
June . .	164	November .	18,579
		December .	3,509
Carried forward	1,277	Total .	39,107

Number of Lowestoft boats employed, about . . 251
,, Scotch and other boats employed, about 413

XIV.

NATURAL HISTORY NOTES FROM YARMOUTH.

By Arthur H. Patterson.

Read 31st March, 1908.

1907.

Than the year 1907, I do not recall to mind a less interesting one, from a natural history point of view: the summer was abnormally unpleasant, and I visited Breydon only at very uncertain intervals, and then with little hope of seeing birds of more than ordinary interest. In matters piscine, the same long, dreary months of gloom and chilliness made almost hopeless the quest for rare or interesting species; and I think I can safely say I never wrote the last line in my "note book" with less regret at the year's ending.

The only fish that I was enabled satisfactorily to add to the County fauna was the Four-horned Cottus (*Cottus quadricornis*), one of which obligingly took the bait of a sea-angler fishing from one of the piers, who eventually spoiled it as a "specimen" by pickling it in brine (he was a pork butcher), as if it had been a ham, and then trying to set it up. The shrimpers helped me exceedingly little, for, as they assured me, "they'd got enough to do to scrape up a livin' without botherin' about curios!" It has been a matter of surprise to me how these poor fellows remained solvent, and saved their little craft through a long trying winter, which, however, some considerably shortened this spring (1908) by getting to work with their boats in February, a month earlier than is their wont. They confessed to being driven to it. Strangely enough, they have fallen in with the "Pink Shrimps," or Æsop's Prawns (*Pandalus annulicornis*)

unusually early this year, the earliest for such an event that has occurred for about eighteen years. "Brown Shrimps" (*Crangon vulgaris*) have been as phenomenally scarce. I suggested to these men that the slightly higher temperature of the water was the cause of their early inshoring, in which theory they acquiesced. The "Pinks" were very small, not half grown in fact, but an immense proportion were heavy in berry at the latter part of February.

Snipe at the beginning of January (1907) were exceedingly poor, indeed they were bunches of bone and feathers, owing to the protracted winterly weather of the preceding December making food all too scarce.

January 28th. Albinos among Black Rats (*Mus rattus*) are exceedingly rare; the only one that ever came to my notice was killed on this date by a cat in a row on the South Quay. But for the cat's appetite having been already appeased by devouring a couple which were of the normal colour, that she had also captured, this unique example would have been spoiled. She gave it up without protest after having killed it. The large ears, and other characteristics, save colour alone, were at once apparent: it had pink eyes, the fur was of a pale bluish white, and the slender tail a trifle shorter than is usual in examples of the same size. Black Rats appear to me of late to have been somewhat on the decrease: they are most industriously trapped by irate householders, and cats swarm in such numbers that the wonder is any rats survive at all.

January 30th. A Conger measuring 6 ft. 8½ ins., and weighing 53 lbs., was brought into Yarmouth, from Southwold Bay.

An attempt was made openly to introduce Dogfishes in the town as food in January: an itinerant fish-seller carting them round with his other wares as an article of food. The experiment was not a success, and I question whether, in this locality at least, they will ever become popular.

At the end of January a fine male Smew (*Mergus albellus*) was shot on Breydon.

On February 6th a small Mackerel was seen to be in

difficulties at the entrance of the sewage-tainted Bure. Noticing its erratic movements, an interested person with very little difficulty seized it by hand. It measured 12 inches in length.

February 9th. It is very probable that a freshly taken Torpedo Ray (*Torpedo vulgaris*) which I purchased off a fish-hawker, had been captured in our local waters. Its colours were yet unimpaired, and it certainly could not have been out of the water twelve hours. I tried whether it were possible to be "shocked" by it, but it probably loses its electrical properties at death. This is not the case with Jelly Fishes which retain their stinging powers long after they are dead.

From the same man I obtained a Starry Ray (*Raia radiata*), about the size of an ordinary dinner plate on the 20th. This example was also in a fresh condition; and from its mouth I pulled out a Skulpin (*Callionymus lyra*).

February 14th. I was shown a Pink-footed Goose (*Anser brachyrhyncus*) shot at Buckenham. It was remarkable for its unusually small size.

On March 3rd. amongst a consignment of Sprats brought over from Lowestoft to Yarmouth, were three adult examples of the Four-horned Cottus (*Cottus quadricornis*); and the purchaser knowing my interest in strange fishes kindly forwarded them to my home. I was delighted to immediately identify them as belonging to the above species, having for a number of years hoped to meet with it, but without avail. They measured 8½ inches in length, and had been captured just south of Lowestoft; their love of the luscious Sprat was their own undoing. The locally-taken example has already been referred to. With the Cottus, from Lowestoft, came five Broad-nosed Pipe-fishes (*Siphonostoma typhle*).

March 4th. A fine example of the Ballan Wrasse (*Labrus maculatus*) 3½ lbs. in weight brought in.

March 9th. Wigeon numerous on Breydon.

March 30th. A very beautiful Smeared Dab (*Pleuronectes microcephalus*) came to hand. The upper surface was of the normal colour, but the surrounding fins were perfectly white. In this species variations seldom occur; the Turbot, Brill,

and Plaice being more subject to abnormalities in colour than any other of the "flat" fishes.

The Wigeon had left Breydon by the 31st, the fine weather then obtaining, having probably tempted them northward.

April 23rd. A Corncrake (*Crex pratensis*) brought me from Acle, that had killed itself by striking a telegraph wire. The increased erection of telephonic and other wires seems to prove increasingly disastrous to birds flying at night.

April 28th. A number of heads of the Tope (*Galeus vulgaris*), a large species of Dogfish, had washed ashore. A highly suggestive incident.

May 10th. My first "all-night sitting" on Breydon for the year was rewarded with the sight of 3 Shield-ducks; 24 Grey Plovers; many Whimbrel; a small wader which I am convinced was a Temminck's Stint; and a "trip" of Swallows. Saw also a young Spoonbill on a flat near my houseboat, which sat preening his feathers for a considerable time, and afforded me a fine chance to sketch him in various attitudes. Early next morning I saw 52 Grey Plovers.

Early in May two Dippers were seen by the park-keepers in St. George's Park. The description of colours and behaviour as given me by the head-keeper (who is an observant man) quite convinced me as to their identity; and he himself had compared them with plates of the species.

May 17th. I saw a very stumpy Cod of 20 lb. weight; its disproportionately huge head was one-third its entire length.

Many days in May were as cold and bleak as in November. On the 18th I noticed Swallows and House Martins seeking food, just as they do in late autumn, along and among the ditches; the same conditions of shelter obtained by the drowsy insects are welcomed by these poor little birds from warmer climes.

May 26th. Some Little Terns (*Sterna minuta*) and about 50 Ringed Plovers on Breydon, the latter extremely laggard travellers which, it is probable, did not concern themselves about domestic matters this year.

On May 26th Jary, the watcher, told me that he had

recently captured a Sea-Angler (*Lophius piscatorius*) in a smelt-net on Breydon, from which, on opening it, he obtained the following assortment of fishes :—

4 Flounders, the size of one's hand.
1 " Slip " (small Sole).
3 Viviparous Blennies (" Eel-pouts ").
6 " Whitebait " (young Herrings).

And on the previous day (May 25th) he had observed five Knots in the " red " ; and as many, on May 13th, as fifty or sixty, a very rare circumstance of late years on the spring migration.

On the 26th May, a nearly adult Gannet (*Sula bassana*) had entangled itself in the Mackerel nets off the Norfolk coast ; a very late date for its presence in this neighbourhood. It was brought in by its captors, who, not knowing what to do with it, threw it into the river, from whence it was retrieved by an old man with a boat-hook. On the 29th I was asked to go and see it ; it sat very contented in a large hamper, and snatched fish from its captor's hands as eagerly as if it had been brought up to the manner. It had managed in between times to punish the old man severely by mauling his finger and stabbing his hand with its sharp strong beak. Procuring a thinly woven onion-bag I turned the protesting bird into it, and carried it home, not without some terrible struggles on its part, and several times pushing its bill through the bag. I despatched the bird to Mr. J. H. Gurney, with whom. I believe, it still remains.

June 1st. Saw a male Lesser Tern feeding his mate with juvenile Herring ; it appeared to me to be either a crippled or a weakly bird. He announced his success and his coming noisily enough, the female responding with equal ardour.

June 9th. A very late Greenshank (*Tringa canescens*) feeding near my houseboat. For a day or two a couple of very immature Spoonbills had been making themselves at home on the flats.

On June 15th a shrimper procured for me a specimen of the White Goby (*Latrunculus alba*).

June 19th. A fish-hawker brought round to me a small

Sole (*Solea vulgaris*) which had at no period of its existence possessed a tail. The fish was perfectly oval, the posterior extremity corresponding in form to the anterior end; the fins ran completely round. It measured 7 inches in extreme length, with a width of 3½ inches, inclusive of the fins.

Jago's Goldsinny (*Ctenolabrus rupestris*) came to hand on no less than three occasions, viz. :—One on June 24th, another on August 6th, and a third a little later on. Three examples of this fish in one summer suggested an unusual number in this locality, which is singular, seeing that up till June, 1906, I had never before met with it in this neighbourhood. The specimens were a little over 3 inches in length.

Considerable "bunches" of young Starlings on Breydon marshes latter end of June. Several young Herons on Breydon June 30th; they were very industriously searching for small Eels.

July 7th. A Greater Weever (*Trachinus draco*) taken in a smelt-net on Breydon; the Lesser Weever (*T. vipera*) was numerously taken in July and August.

July 13th. A Nuthatch (*Sitta cæsia*) captured on the Beach Gardens, was placed in a cage, where it roosted at night hanging head downwards from the perch. It was, however, so restless and excited by day that it injured its head, and died after a few days of prison life.

On July 19th a Sturgeon (*Acipenser sturio*) weighing 20 stone 7 lbs., was on view in the town, having been captured by a Lowestoft smack.

August 4th. Two adult Oyster Catchers (*Hæmatopus ostralegus*) fast asleep, nearly all the afternoon, on the edge of a flat.

Black-headed Gulls are extremely partial to the small Red Ragworm (*Nereid*) which swarms the muds in myriads. A flock of these birds will alight at a given spot, scatter in extended file, and advance head to wind, often walking a mile in a slow and methodical manner, seizing and dragging out these worms as they travel. A considerable flock must devour many thousands in the course of an hour's ramble, for they are pulling them out and swallowing them at every two or three

steps. All during August these birds feed greatly on this worm. On August 9th, some little time before an advancing flock reached my houseboat, I had thrown out the remains of a Plaice, thinking the white bones and scraps would certainly appeal to them, but although several drew up and cast a glance at the offal, they would not touch it, but immediately returned to their worming.

On August 13th the tide had very quickly fallen from the flats near Jary, the watcher's boat, leaving stranded some hundreds of small (3-inch) Herring "syle." The Black-headed Gulls, and Terns (of which Breydon was "full" this autumn) had a right royal time, snapping them up out of the puddles and from the "grass" (*Zostera*).

August 14th. A Bar-tailed Godwit (*Limosa lapponica*) was shot on the Bure by a wherryman, who showed it to a policeman stationed on the Southtown bridge, just after he landed, asking him if he could tell him what it was! The policeman innocently referred him to me, instead of taking his name and address, and confiscating the bird. I saw a solitary Godwit on Breydon on the 17th.

On August 18th Terns were flying all over Breydon. Several Arctic Terns (*Sterna macrura*) joined the Common Terns and fished with them. They were easily distinguishable by their longer tail feathers, higher-pitched notes, and the habit of hovering, Kestrel-like, and in rather more elevated positions above the water than the common species. I noticed that directly a Tern struck a fish too large to easily swallow, it did not attempt to negotiate it, as the Heron does, but dropped it instantly. A Kestrel flying over Breydon was at once set upon and chased quite to the opposite bank. A Rook was mobbed unmercifully, one daring Tern attacking it from below drove it upwards; repeated charges were made by the plucky little fellow, the Rook still soaring as if bewildered, instead of beating a retreat, until it became a mere speck in the sky, when the Tern itself could only at intervals be recognised as it turned and caught certain lights upon its plumage.

When the water is "sheer" (clear), as it becomes directly the wind gets to the east, the "syle" are quicker to see the descent

of the Terns, and their dashes to escape necessitate a stronger plunge to reach them, at which times the birds almost disappear below the surface. On other winds the water is "thicker," and the little Herrings playing at the surface are easily and daintily snatched by the sharp-pointed bill, without so much as wetting the Tern's plumage.

On August 18th four Reeves (probably immature Ruffs and Reeves) passed me. On this date I went smelting with a Breydoner; we took about ten score, and with them many Atherines (*Atherina presbyter*). I examined some young Herrings which I found packed with Opossum Shrimps, from the stomach of one, 4½ inches long, I turned out quite a thimble-full—perhaps 120 Shrimps all told.

Redshanks were scarcer all August: I think they had a bad nesting season.

August 20th. I saw a Grey Plover with the breast as black as in springtime.

The Greenshank is peculiarly addicted to hopping on one leg, feeding as he goes; no bird have I noticed that so persistently pursues this habit. I saw two hopping together on August 21st. When feeding, Redshanks probe as they go, making detached figure "8's": the Greenshanks join their "figure 8's" in a long continuous zig-zag line. The Redshank seldom bores, preferring to pick up its food: its last task, usually, before taking to flight, unless put up, is to wash its breast.

On August 21st, on opening a Flounder, to prepare it for the fry-pan, I found a small one of its own species in its stomach, an unusual circumstance.

August 24th. Quite 100 Curlews on the mud flats.

After the long spell of immunity from persecution which the close season now affords, and before the banging of guns is heard on every hand, and they are being harassed day and night, coupled with the incursion of young and confiding birds, the various species of Gulls, Sandpipers, and Plovers, are, in August, generally abundant on marsh and mud flat, and remarkably tame.

On August 28th, a day or two before the shooting season opened, I took a quiet sail and re-explored some of the haunts of my younger days. I put ashore several times to peer into favourite corners, and was astonished in two or three instances with what I saw. Observing a Gull roosting upon a tall stake, I quietly pushed under cover of the "wall" and peered over. There were at least 200 Gulls of mixed species, nearly all of them sitting on the marsh among the bullocks that took little notice of them, unless it was to avoid treading on them as they grazed. The bird on the stake was supposed to be doing "sentry go," but he was a very unsuspicious sentinel. On a marsh nearer home, on crawling up the bank to look over, I saw a horse cooling his forefeet in a small pool of water, and evidently indulging in a day dream; around him were no less than 8 Redshanks, 1 Greenshank, 1 Green Sand-piper, 3 Lapwings, 3 Black-headed Gulls, and 3 Ringed Plovers, the farthest from the animal being not six feet away from it, and none of them more than a few yards from me.

Sandwich Tern (*Sterna cantiaca*). I saw one, and three others were reported to me. the last week in August.

The Knot (*Tringa canutus*) is the slowest wader at feeding time I think I have seen; two, on August 30th, remained busily feeding on a mud flat, probed the mud around them three or four times before making a fresh step; and while a Ringed Plover, the petulant and impulsive fellow! will be scouring a square acre, a Knot will be leisurely probing six square yards.

On the last day of August, as in the previous year, Breydon was alive with birds. Early next morning guns were blazing away in every direction; before breakfast I noticed one fellow near the "lumps" with quite 20 dead (and useless) Terns lying on the floor of his punt. And every lout who carried a shoulder gun with him obtained his quantum. The temptation to kill these pretty creatures seemed irresistible. although they did not know what to do with the birds when shot. The majority were young birds.

On September 12th a Little Gull (*Larus minutus*) was observed at the Harbour mouth.

I saw a Great Skua (*Stercorarius catarhactes*) on the same date harassing some Black-headed Gulls.

September 18th. Saw first Snow-bunting.

On September 28th a Fulmar Petrel (*Fulmarus glacialis*) in excellent preservation, was stranded on the beach at Corton, near Lowestoft. By its condition I suspected it had become entangled in a herring-net and drowned.

On October 2nd I was much interested in watching the behaviour towards a lot of "Grey" Gulls of a Great Skua, near the harbour mouth. He sailed around, manœuvring like a veritable pirate, and selecting now and again a Gull that had stooped to pick up a floating Herring, went at it open-mouthed at a terrific speed, much swifter than the flight of the screaming Gull. It did not in every instance secure the coveted garbage (for the dead Herrings washing ashore were nothing better), and in one or two instances settled on the water evidently eyeing with disgust the fish sinking below the surface. The bird stayed around for several days, and although eagerly sought, was not shot.

Same date: "Daddy Longlegs" or Tipula were being driven by the strong westerly wind in great numbers, their long ungainly legs bending under many of them as they struck the wet sand and were bowled into the wash. This occasional drowning of noxious insects must be a boon to agriculture.

On October 3rd and 4th a few migratory Larks were flying leisurely in. The usually pronounced influx of these and many other species was not very apparent off this particular part of the coast during the 1907 immigration. Redwings were noticed in St. George's Park on October 8th. Home-bred Thrushes were unmistakably working southwards. A large flock of male Chaffinches same date.

On the night of October 9th, a Purple Heron (*Ardea purpurea*), crouching on the metals was observed at Lowestoft. The tram-men stopped the car and easily captured the bird, which lived for some time in a fowl-run belonging to Mr. E. V. Sterry. It is now in the Norwich Museum.

October 11th. I had word brought to me that a queer bird was to be seen on board a certain fishing-boat at the Fish

wharf. On clambering aboard I was taken to the vicinity of the net-room, where I saw a poor Short-eared Owl doing miserable penance in a herring-barrel forefronted with a bit of herring-lint.

On October 13th first Hooded Crow observed coming in. Many *Corvidæ* trooping in on the 19th. Wind strong S. W. by S.

October 17th. A Peregrine Falcon most persistently gave chase to a Greenshank near the entrance of Breydon, the latter screaming vociferously, and two or three times seeking refuge by diving into the water. The Falcon pursued the wader quite up to the vicinity of the town, when it wheeled around and went back disappointed to Breydon, on which its would-be quarry dashed over the houses on the east side of the river and made good its escape seawards.

On the 20th October I saw a Garfish (*Belone vulgaris*), 9 inches long, tipped out of the water, at the entrance of Breydon, by a lad who was fishing for Flounders, who observed it struggling among some seaweed in a space between some floating timber-baulks.

October 23rd. A Pomatorhine Skua (*Stercorarius pomatorhinus*) brought in from the herring-grounds; it had been entangled in the nets.

Saw a Wheatear (*Saxicola œnanthe*) as late as October 24th.

Grey Wagtails (*Motacilla melanope*) would seem, from the reports given me by bird-catchers, to have been by no means uncommon during October.

November 3rd. A Grey Shrike (*Lanius excubitor*) shot in a garden near the Bure; and a decided inrush of Redbreasts.

November 14th. A remarkable number of Piked Dogs (*Acanthias vulgaris*) netted among Smelts on Breydon. Some were 2 feet in length. I fear I rather cruelly amused myself by turning two or three into a ditch which was brackish, at the rear of the "walls," where they swam in brisk undulating fashion as if they did not much mind the change.

November 16th. A West-countryman in the market with a large tub of wild Rabbits, slung in couples round the tub. I observed numerous Scoters; he assured me he had brought

80 (mostly young birds) and that they sold freely enough, he making a shilling a brace of them. This seemed to be truthful enough, for I had noticed several persons taking couples home, thinking, no doubt, of a "nice cheap dinner" on the morrow. I did not envy the purchasers of these fish-tainted diving birds. The man assured me these birds were killed *near Thetford*; did he mean *near Lynn*?

December was an exceedingly blank month. No Geese were reported; Ducks of all sorts in the immediate locality were conspicuously scarce. It was not until the last day or two of the year that frosts set in, and a few birds, temporarily frozen out from the Broads, visited Breydon.

The Herring shoals were large, and record catches were made; these were followed by huge squadrons of Gulls, which had a good time gleaning up putrid Herrings on the shore; as well as pilfering fresh supplies when they chose to visit the fishing fleet. Cetaceans were scarce, no large species being reported; only two or three Porpoises, thrown out from the herring-nets, were washed ashore. During a spell of easterly winds various flotsam was cast up, to which were attached colonies of Goose Barnacles (*Lepas anitifera*), to the great wonder and interest of ramblers by the seashore.

XV.

THE LATE SAMUEL C. SOTHERN.

By Horace B. Woodward, F.R.S., F.G.S.

In the death of Samuel C. Sothern, at the advanced age of 84, on the 30th September, 1907, Norwich lost a citizen who had done much, in a quiet way, to advance interest in literary and scientific pursuits. In early manhood, prior to about the year 1860, he had been a bookseller at Yarmouth, and in this occupation, so congenial to his tastes, he acquired a knowledge and love of English literature, more usual with those who conducted business according to the methods of fifty years ago than with the majority of present dealers in books. In science, Natural Philosophy as it was understood at the same period, occupied much of his attention. Soon after he settled in Norwich, about the year 1864, he came under the influence of John Ellor Taylor, and attending the classes and excursions conducted by that genial and popular naturalist, he acquired a keen interest in geology. Then was formed, mainly through the influence of the Rev. John Gunn and J. E. Taylor, the Norwich Geological Society, of which S. C. Sothern was one of the original members, and for some time Honorary Secretary.

In 1870, Taylor founded the Norwich Science Gossip Club, with a nucleus of his "old boys," among whom S. C. Sothern became an active member, and, during the Session 1876-77,

President of the Club. In his address in June, 1877, he remarked :—

"No doubt we may not be quite free from the dilettante spirit . . . But if we are open to the charge I have mentioned, there is another side. Does not the meeting together of congenial minds for a common purpose, promote the spirit of inquiry? . . . So we will invite our critics to come among us, and, perchance, in the future before us, we may be reminded of that famous picture of Solomon's, 'The Scoffers,' and those who come to scoff may remain to pray. We will show our censors that the reverent spirit of inquiry is not absent from us, though not wrapped in the hard jargon of the schools."

The foundation of the Science Gossip Club was a memorable achievement, and it is good to know that the Club has steadily gained a higher position, while still maintaining the informal and social character of its gatherings.

Mr. Sothern became a member of the Norfolk and Norwich Naturalists' Society in 1873, resigning, however, in 1878, as his interests in Natural History were practically confined to geology.

Those who knew him at home, in the meeting-room of the Science Gossip Club, or in the field, will recall with pleasure his sanguine and enthusiastic temperament. An optimist, amid many trials, and with a constitution never robust, his philosophy was at all times salutary and an example to weaker brethren.

XVI.

PROPOSAL FOR A BOTANICAL SURVEY OF THE BROADS DISTRICT.

A SUGGESTION made in my paper on the "Bionomical Botany of Sutton and the Ant District"* for a detailed Botanical Survey of that District, has been followed up by a proposal for a Botanical Survey of the Broads District, and later on, if practicable, of the whole county of Norfolk. The proposal was brought before a meeting of the Society on 28th January, 1908. The co-operation of members of the Society interested in Botany was invited, Mr. Robert Gurney offering to supply a copy of the 6 in. O.S. sheet gratis to any capable person who would lend a hand in the work. Work of this nature has already been accomplished in Scotland, Yorkshire and Somerset, and the results of the two latter surveys published in the Royal Geographical Journal. References to some of the literature of Botanical Surveys are given below.

In order to ensure uniformity in the results, the following scheme for mapping the vegetation on a 6 in. O.S. sheet, has been drawn out. Different colours with set-in letters are here suggested, but need not be rigidly adhered to, provided that the worker makes it quite clear what his various symbols or colours refer to. The results obtained on the 6 in. maps

* Trans. Norfolk and Norwich Nat. Soc. vol. viii. p. 288.

would be finally reduced to a scale of 1 inch or 2 inches to the mile, being then embodied in a single map.

SCHEME FOR BOTANICAL MAPPING.

WOODLAND.—Deciduous, Oak (O), Beech (B), etc.	Emerald Green.
Mixed Deciduous and Parklands (MD)	Viridian.
Coniferous (P)	Sap Green.
Alder (A) and Osier carrs (O)	Olive Green.
CULTIVATION.—Ordinary	Yellow Ochre.
Grassland (Gr).	Chrome Orange
COMMONS.—Dry Heath and Heath-pasture with Heather (H) and Gorse (G)	Madder Brown.
Wet Common (with *Drosera*, &c.), with more Grass and Turf than in Grazing-marsh	Light Red.
MARSHLAND.—Drained Grazing-marsh (with more or less *Juncus*)	Naples Yellow.
Undrained—Mowing-marsh*	Lemon Yellow.

* Mowing-marsh. The yield of a mowing marsh is used largely for litter, and may consist of a considerable variety of species. Amongst species frequently occurring in a mowing-marsh, may be found *Juncus Rhinanthus*, *Epipactis palustris*, Crantz, *Œnanthe fistulosa*, L., *Angelica sylvestris*, L., *Salix repens*, L., *Aira cæspitosa*, L., *Molinia cærulea* Mœnch., *Lastrea Thelypteris*, Bory

It will probably be found necessary to sub-divide this into smaller associations. For example, *Molinia-Agrostis* and *Juncus* Marsh with perhaps, Marsh thicket comprising sparse Sallow, Myrica, and Alder.

Sphagnum (S) and Eriophorum (E) Bog	Gamboge.
AQUATIC.—Erect or emergent. *Phragmites*, *Typha*, *Cladium*, etc.	Cobalt.
Rooted, with submerged or floating leaves. *Stratiotes*, *Hydrocharis*, etc.	Antwerp Blue.
Free-floating, *Utricularia*, *Lemna*, etc.	Ultramarine.
MARITIME.—Strand. *Cakile maritima*, etc.	Carmine.
Dune. *Ammophila*, *Carex arenaria*, etc.	Scarlet Lake.
Dune-sward and Marsh (*e.g.*, Yarmouth and Lowestoft Denes)	Rose madder.
Mudflats (tidal area). *Salicornia*, *Statice*, etc.	Vermilion.
Salt-marsh. *Atriplex*, *Suæda*, etc.	Purple Lake.
Reclaimed Grazing-marsh (probably with *Aster Tripolium*, L. and *Cochlearia*, indicating more or less brackish conditions)	Mauve.

Suggestions for Notes and Observations.

Each sufficiently important portion of land or water marked as distinct on map to receive a number whether taken from 25 in. map or purely arbitrary. All notes on occurrences of plants can then be referred to numbered locality. Complete lists to be regarded as of first importance, rare plants as only incidents, Rare plants should, of course, be specially noted. with particular reference to the plants with which they are found associated and their surroundings. A rare plant may be a mere casual immigrant, or it may be of first importance as indicating some special quality in the surroundings, for example, *Liparis*, *Drosera*, *Pinguicula*, &c.

Characteristic groups or associations to be particularly noted and special attention directed to any physical features which can be detected as influencing, or likely to influence their nature and habit. Such features may be nature of soil (particular reference to drift-map), depth of water and nature of bottom, influence of tides, if any, and of current, exposure to wind, etc.

Notes should be made of the influence of animals and of man.

Observers should attempt to summarise their notes before sending them in. All notes to be sent eventually to Mr. W. A. Nicholson, Hon. Sec., 51 Surrey Street, Norwich, without prejudice to observer's right to publish any observations directed to special personal end. Maps will eventually become the property of the Norfolk and Norwich Naturalists' Society, or The Sutton Laboratory, as shall afterwards be determined, and be at all events open to use of members for subsequent work.

Members wishing to assist in the work are requested to communicate with the Hon. Sec., as above. A perusal of any of the papers mentioned below will be useful for forming an idea of the nature of the work required.

"Plant Associations of the Tay Basin." Robt. Smith, B.Sc. Trans. and Proc. Perthshire Soc. Nat. Science, vol. ii. part 6, 1897-98.

"Geographical Distribution of Vegetation in Yorkshire." Dr. W. G. Smith and W. M. Rankin. The Geographical Journal, vol. xxi. p. 375, and vol. xxii. p. 149.

"Geographical Distribution of Vegetation in Somerset, Bath and Bridgwater District." C. E. Moss, M.Sc. Royal Geographical Society, London, 1907.

"Suggestions for Beginning Survey Work on Vegetation." Reprinted from the New Phytologist, vol. iv. No. 4, April, 1905.

"Sketches of Vegetation at Home and Abroad." IV. Wicken Fen. By R. H. Yapp, M.A. The New Phytologist, vol. vii. Nos. 2 and 3 February and March, 1908.

NOTE.—Unfortunately, some weeks after our proposal was brought before this Society, it was ascertained by Mr. Gurney, that two ladies, the Misses Shaw and Pallis of Liverpool, had already commenced a survey of the Broads District, which the Royal Geographical Society has agreed to publish. I do not think this fact ought to deter us from prosecuting our Survey. A local Society must have many members who possess a considerable amount of knowledge of the natural phenomena of their district, a knowledge which cannot be acquired by those non-resident in the district, in the short space of time which they could necessarily devote to its acquirement.

W. A. NICHOLSON. *Hon. Sec.*

XVII.

MISCELLANEOUS NOTES AND OBSERVATIONS.

WILD BIRD PROTECTION ON THE NORFOLK COAST.

It is with great pleasure that we again refer to the excellent results of the efforts of the various local Bird Protection Societies to preserve to us the colonies of those breeding birds which were in danger of banishment from the localities they had so long graced with their presence ; the only matter for regret is the slight amount of pecuniary support their good work receives, and one wonders how so much is effected by such slender means. The past year has been marked by the loss of one of the members, who by his sympathy and liberal subscriptions to three of the societies has been so materially helpful, and it will be difficult in both respects to fill the gap created by the death of Professor Newton, to whom the modern appreciation of our duty to these things of beauty is so largely due—can we imagine the desolation of the shore if deprived of the presence of the Gulls and Terns ?

From Wolferton, which Society enjoys the patronage of H.M. the King, the Prince of Wales and Mr. Hamon le Strange, it is reported that both Common and Lesser Terns, also Ring Plovers, have again increased in numbers, and two or three pairs of Sheld Ducks nested, "probably stragglers from the large colony on Wolferton Heath." On April 10th, eggs were seen of the Lapwing and Ring Dotterel, and first eggs of the Common Tern on 10th May, those of the Lesser Tern on 15th May, and on 8th July there were still a few Common Terns and Ring Dotterel sitting. Mr. George Cresswell is the Hon. Secretary, and the funds seem sufficient for the purpose.

Blakeney and Cley.—Mr. Quinton E. Gurney, the Hon. Secretary, reports favourably and adds some interesting notes from the watcher's diary.

The Terns began to arrive on April 28th, but the watcher did not go on duty till May 20th, on which date he found both Lesser Terns and Dotterel's eggs: on the 14th of the same month an Oyster-catcher's nest with two eggs had been found. The first Common Tern's eggs were found on May 26th, and the first Sheld Ducks hatched on the same day. First Ring Dotterels hatched on 28th May. Three Sandwich Terns were seen on 8th June, and first Lesser Terns hatched on the 10th. On the 12th of June one Roseate Tern was seen, also again on 5th July. On 14th June, Oyster-catchers hatched off, and on 19th first Common Tern, on July 3rd a brood of 15 young Sheld Ducks was seen.

It was found necessary to institute one prosecution, which fell heavily on the scanty funds of the Society, resulting in leaving a balance due to the Treasurer; but it is interesting to learn that "two of the Oyster-catcher's eggs which had been stolen, but recovered by the watcher, duly hatched off." The income of the Society amounted to only £11 10s.

From the WELLS Society the report is not quite so favourable. An outlay of 19s. was incurred for poisoning Rats, which in this district constitute a serious annoyance. Mr. C. A. Hamond of Twyford Hall, the Hon. Secretary, states that "although there were not so many nests, there were no severe storms nor did many of the young birds die." One interesting feature is the increase of the colony of Black-headed Gulls in their ancient nesting place, "Mow Creek:" there were twelve pairs of birds nested there as against six pairs in the previous year; the first nest of these birds was hatched off on June 17th and the last on July 10th. The watcher's diary gives May 20th as the first nest of Lesser Tern's eggs, May 25th first young Redshanks, and on 26th first eggs of Common Terns. June 2nd, five young Sheld Ducks were seen, and on the 8th three young Ring Dotterels. June 14th, a Roseate Tern seen. June 18th, first Lesser Tern hatched, and on 19th, first Common Tern. July 30th, two Sandwich Terns flying over.

The whole amount subscribed for 1907 only amounted to

£7 3s., and the year ends with a balance against the Treasurer—surely this should not be.

The Report from BREYDON, of which Society Mr. H. P. Frederick of Yarmouth is Hon. Secretary, gives no particulars of the work for 1907, but the benefits conferred by the Watcher on this favourite resort of Water-fowl are well known, and its work is continued through the whole of the close time; it is, therefore, to be hoped that Mr. Frederick's appeal for increased subscriptions to make good the loss by death and otherwise may not be in vain.—T. S.

FOREST-BED SEEDS.—Mr. Clement Reid, F.R.S., in letter to the Honorary Secretary writes as follows: "I wish some of the Norfolk Naturalists would help with the collecting of Forest-Bed Seeds, especially from Pakefield and West Runton. We should be glad to determine them. By Mrs. Reid's new method of washing (explained at the Linnean Society last night, 6th Feb., 1908), the collection is rendered much easier. All that is needed is to boil the lumps of clay or peat with plenty of washing soda, pour into a sieve, and then hold under the tap till the water runs clear. The contents of the sieve can be placed in clean water, with a little preservative (alcohol or formalin) and bottled for future examination.

There is no need to dry the material; and by this method peats—formerly thought hopeless—are perfectly disintegrated, so that delicate seeds and even portions of leaves are washed out uninjured. The West Runton peat has never been properly examined, but is likely to yield species unknown at Pakefield."

MAMMALIAN REMAINS.—On December 2nd, 1907, Mr. J. C. Stevens sold the extensive collection of fossil mammalian remains formed by the late Mr. James Backhouse of York. The chief lot was a lower jaw of the Machærodus, or Sabre-toothed Lion, from Kessingland, of which remains in the Forest-Bed are exceedingly rare, only one or two teeth being known before the finding of this jaw, which was described

and figured by Mr. Backhouse in the 'Journal of the Geological Society,' in 1886. It was purchased for the Dublin Museum at £14 14s. Among the specimens dredged from the North Sea were an *Elephas* femur of gigantic size, £1 10s.: and the lower jaw with teeth of a Rhinoceros, £1 5s. The mammalian and other remains from the Norfolk Forest-Bed included two lower jaws with teeth of *Rhinoceros etruscus*, £1 12s. 6d. and £1 1s.; and an exceptionally fine skull with parts of both antlers of *Cervus verticornis*, £3 15s. Among the specimens from the Red Crag of Suffolk were a number of teeth of *Mastodon arvernensis*, which varied from £1 to £3 per lot.

Notes on the Flosculariæ of the Great Yarmouth District. *Read April 20th*, 1907:—For several years past I have searched for this beautiful fixed Rotiferon in the waters of the Great Yarmouth district, and have been successful in finding them year by year in the same localities, which include the following:—West Caister (next Caister-on-Sea). Gt. Ormesby. Burgh Castle (in private lake). Southtown Marshes. Gt. Yarmouth. Fritton Lake. Lound Run.

So far my collections include three species, viz.:—*Floscularia ornata*, *F. cornuta*, and *F. ambigua*.

The animal has a great predilection for various mosses growing at the borders of some of the cleaner ditches, and loves to ensconce itself in the hollows of the boat-like leaves of these tiny plants. One year I found *F. ornata* in good quantity on some floating moss in Fritton Lake: these were specially beautiful on account of the absolute transparency of their bodies—a condition peculiar to most lacustrine Rotifers. These have generally been associated with *Philodina*, *Rotifer vulgaris* and similar forms, but are somewhat awkwardly placed on account of being partly hidden in the leaf hollows. The water plant *par-excellence* upon which to find the Floscule is *Myriophyllum* which grows in dense masses in the brackish ditches in the vicinity of the mouth of the Yare, where there is a net work of these useful water-ways used for draining the marshes. I have found this "weed" in all parts of Norfolk

and Suffolk; but while finding occasional tubes of *Melicerta* upon it have rarely met with the Floscule. My own experience is that it prefers the decidedly brackish and almost salt water to be found in ditches at the mouths of rivers. This, of course, does not apply to Lound Run and the lake at Fritton, but in these fresh-water situations the forms are not nearly so numerous or so fine as those found at Southtown which is a sure ground for them. In some recent gatherings I have simply taken a handful of *Myriophyllum* from a ditch and having separated two or three of the multiple leaves and placed them in a watch-glass or micro-tank, simply revelled in their beauties. I counted as many as 47 Floscules on one "Frond" (pinnate leaf), and as there are scores of these "Fronds" on one stem, the gregariousness of the animal can be better appreciated than stated. Under a Rousselet compressorium (the best way to examine the fixed Rotifers) and using a one inch objective I have frequently had as many as ten or twelve Floscules in the field at one time. This affords a unique and exceedingly fine opportunity of studying the animal as, if supplied with a fresh drop of water occasionally, it can be kept alive and under continuous observation for several days.

April and May are the best months to find the Floscule in the above waters.—H. E. Hurrell.

Lophopus Crystallinus.—Mr. H. E. Hurrell reports that he has found the Polyzoon in the river Yare in greater abundance than ever, and has taken it at both earlier and later periods than formerly. The statoblasts appear to be formed as early as the month of August, but are found more fully developed at the present period of the year (late October), and are probably at their best in mid-winter when the animal is slowly sloughing off the weed and the statoblasts are liberated.

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CONTENTS.

	List of Officers	v
	List of Members	vi
	Statement of Accounts	x
	Catalogue of Additions to the Library	xi
	President's Address	499
I.	In Memoriam: Professor Alfred Newton, F.R.S., and Mr. Howard Saunders	517
II.	The Salt-marsh Flora of Wells. By Frederick Long, L.R.C.P.	523
III.	Distribution of *Veronica verna*, L., *V. triphyllos*, L., *Herniaria glabra*, L., and *Scleranthus perennis*, L. By A. Bennett, F.L.S.	528
IV.	Arrival of Migratory Birds at Great Fakenham, Suffolk. By Rev. R. B. Caton	535
V.	Note on a Form of *Leucobryum glaucum*, Schp. By W. H. Burrell F.L.S.	537
VI.	Notes on a Tame Hare By Dr. D. G. Thomson	540
VII.	The Occasional Luminosity of the White Owl (*Strix flammea*). By R. J. W. Purdy	547
VIII.	Norfolk Neolithic Harpoon-Barbs and Triangular Knives. By W. G. Clarke	552
IX.	Some Breckland Characteristics. By W. G. Clarke	555
X.	The Insects of the Breck. By Claude Morley, F.E.S., &c.	579
XI.	Meteorological Notes, 1907. By Arthur W. Preston, F.R. Met. Soc.	587
XII.	Some Additions to the Norwich Castle-Museum in 1907. By Frank Leney	596
XIII.	Notes on the Herring Fishery of 1907. By T. J. Wigg	599
XIV.	Natural History Notes from Yarmouth. By Arthur H. Patterson	604
XV.	The late Samuel C. Sothern. By Horace B. Woodward, F.R.S., F.G.S.	616
XVI.	Proposal for a Botanical Survey of the Broads District	618
XVII.	Miscellaneous Notes and Observations	622

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List of Members willing to receive Specimens for identification.

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The Treasurer in Account with the Norfolk and Norwich Naturalists' Society, Year ending March 25th, 1909.

Dr.	£	s.	d.	Cr.	£	s.	d.
1908—9.				1908—9.			
To Balance at Messrs. Barclay's	1	10	8	By Fletcher and Son, Printing *Transactions*	38	15	6
,, Subscriptions:—				,, Ditto Sundry Printing	1	5	6
3 for 1905—06 £0 15 0				,, Goose and Son, Printing, Stationery, and Postage	4	4	9
7 ,, 1906—07 1 15 0				,, Postage Stamps (Hon. Secretary) £5 8 1			
19 ,, 1907—08 5 14 0				,, Ditto (Assistant Secretary) 1 3 0			
159 ,, 1908—09 47 14 0					6	11	1
8 ,, 1909—10 2 8 0				,, Bankers' Cheque Book	0	1	0
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,, Sale of *Transactions*	2	12	9	,, Norfolk and Norwich Library for Use of Room	1	1	0
,, Interest on Life Membership Fund	1	14	9	,, Doorkeeper at Monthly Meetings	1	0	0
,, Grant from Life Membership Fund for Bookbiuding	10	0	0	,, Assistant Secretary's Salary	5	0	0
				,, Bookbinding—Hayden, £7 1s. 2d.; Garuham, £1 7s. 3d.	8	8	5
					67	2	3
				,, Balance at Messrs. Barclay's	8	2	11
	£75	5	2		£75	5	2

LIFE MEMBERSHIP FUND.

1908.	£	s.	d.	1908.	£	s.	d.
To Balance in Norfolk and Norwich Savings Bank	66	0	0	By Transferred to Current Account for Bookbinding	10	0	0
,, 1 Composition	5	0	0	,, Ditto (Interest)	1	14	9
,, Interest to November 20th, 1908	1	14	9	,, Balance in Norfolk and Norwich Savings Bank	61	0	0
	£72	14	9		£72	14	9

GENERAL INDEX TO *TRANSACTIONS*.

1908.	£	s.	d.	1908.	£	s.	d.
To Donations towards the compiling and printing of a General Index to the *Transactions*	16	5	6	By Paid to Account at Messrs. Barclay's	16	5	6

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Beverley M., M.D.	0	5	0	Feilden Col. H. W., C.B.	0	5	0	Harmer F. W.	0	10	0	Preston A. W.	0	2	6
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Buxton G. F.	0	10	0	Gurney J. H.	5	0	0	Long F., L.R.C.P.	0	5	0	Utting S. W.	0	5	0
Corder E.	0	5	0	Gurney Robert	2	0	0	Long S. H., M.D.	0	10	0	Walter J. H.	0	5	0
Eade Sir Peter, M.D.	0	5	0	Hamond C. A.	0	10	0	Nicholson W. A.	0	5	0	Woodward H. B.	0	10	0
													£16	5	6

March 30th, 1909.

Examined with vouchers and found correct,

STEPHEN W. UTTING. *Auditor.*

List of the Publications received by the Society as Donations or Exchanges from April, 1908.

Ashmolean Natural History Society of Oxfordshire. A Historical Account of the, 1880—1905. By F. A. Bellamy, Hon. M.A. Oxford, 1908. *Presented by the Society.*

Belfast Naturalists' Field Club. Annual Report and Proceedings. Series II. Vol. vi. Part 1.

Birds of Bempton Cliffs, The. By E. W. Wade, M.B.O.U., *n.d.* *Presented by Mr. J. H. Gurney, F.Z.S., F.L.S.*

Bramerton, near Norwich. On the Crag strata at. By Richard Taylor, Esq., of Norwich. From Trans. Geol. Soc. Series II. Vol i. 1824.

Presented by Mr. H. B. Woodward, F.R.S., F.G.S.

Bristol Naturalists' Society, Proceedings of the. Fourth Series. Vol. ii. Part 1. 1908.

British Association for the Advancement of Science, Report of 78th Meeting of the. Dublin, 1908.

—— —— Report of the Corresponding Societies Committee and of the Conference of Delegates, Dublin, 1908.

British Museum (Natural History), Publications :—

Synopsis of the British Basidiomycetes. By Worthington G. Smith, F.L.S.

—— —— Races of Mankind, Guide to the Specimens illustrating the.

———— Elephants (Recent and Fossil) Guide to the.

———— Whales, Porpoises, and Dolphins, Guide to the.

———— Domesticated Animals (other than Horses), Guide to the.

———— Horse Family, Guide to the Specimens of the.

———— Fishes, Guide to the Gallery of.

———— Insects, A Guide to the Exhibited Series of.

———— Rocks, An Introduction to the Study of, and Guide to the Museum Collection.

Presented by the Trustees of the British Museum.

Brooklyn Institute of Arts and Sciences. Cold Spring Harbor Monographs. VII. The Fresh-water Cyclops of Long Island. By Esther F. Byrnes, M.D. Brooklyn, N.Y., 1909.

California, University of. Publications in Zoology. Vol. iv. Nos. 1—7. Oetober, 1907, to April, 1908. Vol. v. No. 1. December, 1908. Vol. vi. No. 1. October, 1908. Berkeley, California, U.S.A.

Cambridge Philosophical Society, Proceedings of the. Vol. xiv. Parts 5, 6. Vol. xv. Parts 1, 2. 1908—09.

———— University Library. Report of the Library Syndicate for the year ending 31st December, 1907.

Cardiff Naturalists' Soeiety, Transaetions of the. Vol. xli. 1908.

Cirripedes from the Trimmingham Chalk. By Henry Woodward, LL.D., F.R.S. Extracted from Geological Magazine. August, 1906. *Presented by Mr. H. B. Woodward, F.R.S.*

Ealing Scientific and Microscopical Society, Report and Transactions, 1907—08.

Edinburgh, Botanical Soeiety of. Part 4. Vol. xxiii.

———— Field Naturalists' and Microscopical Society, Transactions of the. Part 1. Vol. vi. 1908.

———— Royal Society of. Proceedings of the. Vol. xxviii. Parts 5, 6, 7, 8, 9. 1907—08. Vol. xxix. Parts 1—4. 1908—09.

Entomological and Natural History Society, Proeeedings of the South London. 1908-09.

Essex Naturalist, The. Being the Journal of the Essex Field Club. Parts 4—6. Vol. xv. January—July, 1908.

Flora of the Orkneys, Additions to the. By Arthur Bennett, F.L.S. Reprint from Ann. Scot. Nat. Hist. July, 1908. Pamphlet. *From the Author.*

France, Bulletin de la Soe. des Sciences Naturelles de l'Ouest de la. Deuxième Série. Tome viii. 1er and 2e Trimestres, 1908.

Geographical Journal, The. April, 1908—April, 1909. *Presented by Mr. H. G. Barclay, F.R.G.S.*

Geological Society, Quarterly Journal of the. 233—255. *Presented by Col. Feilden, C.B.*

Géologie, Bulletin de la Soc. Belge de. Procès-Verbaux. Tome xxii. October—December. January—July, 1908.

Harvard College, Bulletins of the Museum of Comparative Zoology at. Vol. xliii. No 6. Reports of Dredging Operations and Scientific Results of Expeditions to West Coast of Central America, &c., and in Eastern Tropical Pacific. By U.S. Fish Commission Steamer "Albatross," in charge of A. Agassiz. Mollusca and Brachiopoda. By W. H. Dall. Camb., Mass., 1908. Vol. li. Nos. 10, 11, 12. Vol. lii. Nos. 1—8. Vol. liii, Nos. 1, 2. Vol. xlix. Geological Series. Vol. viii. No. 6, 7. Annual Report of the Curator of the Museum for 1907—08.

Hertfordshire Nat. Hist. Society and Field Club, Transactions of the. Vol. xiii. Part 3. February, 1908. Part 4. September, 1908.

Ibis (The), a Quarterly Journal of Ornithology. April, 1908—April, 1909. *Presented by Mr. G. F. Burton, F.Z.S.*

Ipswich and District Field Club, the Journal of the. Vol. i., 1908. Part 2. *Presented by the Club.*

Linnean Society, Proceedings, 1905—08. Journal (Zoology) 195—198, 203—205. List of Members, 1905—06—07.
Presented by Mr. J. H. Gurney, F.L.S.

Lloyd Library of Botany, Pharmacy and Materia Medica, Bulletin of the. No. 10. 1908. Hydrastis Canadensis. Facsimile Reprint and Illustrations of the Article in Drugs and Medicines of North America, 1884. Mycological Notes. July and October, 1907. January and February, 1908. J. U. and G. C. Lloyd, Cincinnati, Ohio, U.S.A.

Manchester Literary and Philosophical Society, Memoirs and Proceedings of, 1907—08 09. Vol. lii. Part 3. Vol. liii. Parts 1, 2.

Marine Biological Association of the United Kingdom, Journal of the. New Series. Vol. viii. No. 3. October, 1908. No. 4. May, 1909. *Presented by Mr. Robert Gurney.*

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Mollusca of Suffolk, The Non-Marine. By A. Mayfield. December, 1907. Reprint from Journ. Conch.
Presented by the Author.

Montana, University of. President's Report, 1906—07. Register, 1907—08.

——— Pictured Rocks. Indian Writings on the Rock Cliffs of Flathead Lake, Montana. By M. J. Elrod, Ph. D., 1908.

——— Some Economic Geology of Montana. By J. P. Rowe, Ph. D. 1908.

——— High School Debating League. 1908.

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North Staffordshire Field Club. Annual Report and Transactions, 1907—08. Vol. xlii.

Northumberland, Durham, and Newcastle-upon-Tyne, Transactions of the Natural History Society of. New Series. Vol. iii. Part 1. 1908.

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Nova Scotian Institute of Sciences. Vol. xi. Parts 3 and 4. Vol. xii. Part 1.

Peterborough Natural History, Scientific, and Archæological Society. Précis of 35th Annual Report, 1906.

Philadelphia, Proceedings of the Academy of Natural Sciences of. Vol. lx. Part 1, January--April. Part 2, May and June. Part 3, July—December, 1908. Vol. lxi. Part 1, January—March, 1909.

Physical Society, Proceedings of the Royal. No. 5. Vol. xvii. Edinburgh, 1908.

Plants of the Farœ Isles, &c. By Arthur Bennett, F.L.S. Reprints from "Ann. Scot. Natural History," January, 1909. *Presented by the Author.*

Potamogeton Pensylvanicus, Cham. et Schecht., introduced to England. By Arthur Bennett, F.L.S. From Trans. Bot. Soc., Edinburgh. Vol. xxiii. 1908. *Presented by the Author.*

Rennes, Travaux Scientifiques de l'Université de. Tome vi. 1907. 1er and 2e, Partie. Rennes, 1907.

Smithsonian Institution, Annual Report of the Board of Regents of the. 1907.

South London Entomological and Natural History Society. Proceedings of the. 1907—08.

Thoughts on Natural Philosophy (with a new Reading of Newton's First Law) and the Origin of Life. By A. Biddlecombe. Newcastle-on-Tyne, 1909. *Presented by the Author.*

Trimmingham, The Chalk Bluffs at. By Professor Bonney, F.R.S., and Rev. E. Hill, M.A., F.G.S. September, 1905.

——— The Chalk Bluff at. By Professor Bonney, F.R.S. Extracted from Geological Magazine, September, 1905, and September, 1906. *Presented by Mr. H. B. Woodward, F.R.S.*

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Presented by Mr. G. F. Buxton, F.Z.S.

ADDRESS.

Read by the President, Rev. M. C. H. Bird, M.A., M.B.O.U., *to the Members of the Norfolk and Norwich Naturalists' Society, at their Fortieth Annual Meeting, held at the Norwich Castle-Museum, March 30th,* 1909.

Ladies and Gentlemen—In reviewing the progress of the Society for the past Session, the first point to be considered, is that of the number of members. This seems to be quite satisfactory, as we now have a total of 290 members, against 282 in March, 1908—but we have, unfortunately, to record the loss by death of two Vice-Presidents, namely: Lord Amherst of Hackney, and the Earl of Leicester, and three other Members, namely: Sir Edward Birkbeck, Bart., Mr. Samuel Gurney Buxton, and Mr. John Long. Lord Amherst of Hackney, as Mr. W. A. Tyssen-Amherst, was a member of the Society practically from the beginning. His name appears as a Vice-President in the second published list of officers, in 1870-71. He remained a Vice-President till his death, on 16th of January, 1909.

The Earl of Leicester, K.G., who died on 24th of January, 1909, was a Vice-President of the Society since 1873-74.

Sir Edward Birkbeck had been a member for many years, but did not take any active part in the work of the Society.

Mr. Samuel Gurney Buxton of Catton Hall, who died on 12th February last, had been a member since 1870-71. He was much interested in Natural History, and will be long remembered as a keen sportsman.

The Library is increasing so rapidly, that it has been necessary to consider the question of further shelving

accommodation. For books and papers received, amongst others we have to thank Mr. A. Bennett, Mr. H. G. Barclay, Col. Feilden, C.B., Mr. G. F. Buxton, Mr. J. H. Gurney and Mr. Robert Gurney.

I will proceed to refer to the work done during the Session. On 28th April, your President sent some Mosses for identification, which were handed to Mr. Burrell, F.L.S. Mr. Robert Gurney sent some Shells from the Ant, below Ludham Bridge. Mr. Patterson sent some Natural History Notes, and Mr. W. G. Clarke exhibited some Flint implements. On May 26th, Miss M. L. Buxton read some Natural History notes made during a recent trip to Spain. Mr. Patterson exhibited a specimen of a stripeless Mackerel.

On May 28th, by the kindness of Mr. Christie, the members were invited to view the grounds and gardens at Framingham Manor House, and were entertained at tea. About seventeen members and friends attended, and a very pleasant and interesting afternoon was spent. September 29th, a suggestion made by Mr. Robert Gurney, that a complete Index to the Eight Volumes of the Transactions should be prepared, was discussed, and a sub-committee appointed to consider it.

It was eventually decided to entrust the preparation of the Index to Mr. C. Davies Sherborn, provided that the estimated cost, of about £15, could be obtained by donations from members. In a short time the sum of £16 5s. 6d. was collected by the Hon. Secretary, Mr. J. H. Gurney having generously started the fund with £5.

The Index is now in type, as far as possible, and only awaits the publication of Part V. of the Transactions before completion. Mr. A. Patterson read some "Notes from Yarmouth"; Mr. W. G. Clarke, a paper on "A Week in Breckland." Mr. Southwell exhibited, on behalf of Mr. E. N. Connop, specimens of the Desert Wheatear and the Blue-headed Wagtail.

On October 7th, Mr. F. Long, L.R.C.P., gave an account of his Visit to Dublin, as delegate to the Corresponding Societies of the British Association. Mr. H. E. Hurrell sent a note on Hydra, and Mr. A. Bennett a paper on four rare East Anglian plants.

November 24th, a special meeting was held in the Art Gallery of the Castle Museum, to which the members of the Norwich Science Gossip Club were invited to hear Mr. Gerard H. Gurney's paper on his Natural History Experiences in British East Africa, illustrated by lantern slides.

On January 26th, 1900, it was decided to offer the congratulations of the members to Dr. S. F. Harmer, F.R.S., on his appointment to the Keepership of Zoology in the British Museum (Nat. Hist.), and to Mr. H. B. Woodward, F.R.S., on his receiving the Wollaston Medal from the Geological Society. Mr. E. J. H. Eldred read "Observations on the Great Bustard in Captivity;" Mr. H. Dixon Hewitt some Notes on the Drove Road, an ancient Norfolk Trackway; Mr. J. H. Gurney made remarks on the recent abundance of Woodcock, and Mr. A. Mayfield sent a list of Non-Marine Mollusca of Norfolk.

February 23rd. Mr. F. C. Hinde, your Hon. Librarian, alluded to the necessity for increasing shelf room for the Society's Library. A Sub-Committee, consisting of Mr. J. H. Gurney, the Hon. Librarian, and the Hon. Secretary, was appointed to report. (The Sub-Committee subsequently recommended that new shelves should be constructed over the doorway, and on the left-hand side of the door of the room in the library, at an estimated cost of £12; that £10 be drawn from the Life Membership Fund for this purpose, Mr. J. H. Gurney having generously offered to defray the balance.)

Mr. W. G. Clarke read a paper on the "Bird-Life of the Meres of Wretham Heath." Mr. Patterson one on the "Obsolete Mackerel Fishery," and some Natural History "Notes." Mr. J. H. Gurney exhibited two Engravings of

the Bass Rock, taken in 1690. Mr. A. W. Preston's Meteorological Notes for 1908, and Mr. T. J. Wigg's Notes on the Herring Fishery for 1908, were brought forward, and taken as read, and the members then adjourned to the Keep to inspect the magnificent new case of Lions.

On looking through the long and honoured list of our former Presidents, I find that forty years have elapsed since the Norfolk and Norwich Naturalists' Society was founded under the Chairmanship of the Rev. J. Crompton, and not once since his retirement from that office has a member of my profession had the high honour of occupying this chair! But one has only to glance through the Volumes of our Transactions, to see how greatly the Society has prospered, without such benefit of clergy!

Allow me to take this opportunity for thanking most heartily those members to whom I am in any wise indebted for the exalted position which I occupy to-night, an honour as fully appreciated as it was entirely uninvited and unsought, and one which I was only persuaded to accept in consequence of the retirement at the eleventh hour of a more accomplished previous candidate, together with the assurance that, in consequence of my living at a distance from Norwich, I should be let off (unfined) for missing the Monthly Meetings!

May I also, therefore, avail myself of this opportunity to thank you all for your clemency, and especially those gentlemen who have, in my absence, presided over your deliberations far more ably than I possibly could have done!

Now, as to my address this evening, I am no scientific naturalist, merely a dabbler in country pursuits, born as it were, with a gun in my hand rather than with a microscope or science primer before me! Two Golden Crested Wren's eggs, still in my possession, and taken at Kelling Hall in 1864, bear witness, however, to the fact that I started taking some sort of interest in oology soon after I was seven years

old; and a note in my father's game book, to the effect that he took me out Ferreting in 1863, shows that I had an early opportunity at any rate of studying the rodents, although I am afraid that sport rather than science was thereby encouraged in my youthful mind. My immediate predecessor in this chair, in his presidential address last year, took your thoughts instructively away into the Highlands of Scotland, and on to the precipitous and rocky islands of the West coast of Sutherlandshire. To-night I am about to invite your attention to no such foreign parts, but would ask you to accompany me to the lowlier level of our own homeland. The broads and rivers of our county have been fairly well threshed out, literally, both by scribes and anglers; I purpose, therefore, to make a few remarks this evening upon a less threadbare though somewhat similar subject (so far as the Fauna and Flora are concerned), namely.

THE RURAL ECONOMY, SPORT, AND NATURAL HISTORY OF EAST RUSTON COMMON.

One of the few enclosed wet commons of any extent in England, the latter day history of which ought not, I think, to be buried in entire oblivion.

The parish of E. Ruston (so called to distinguish it from Sco' or South Ruston, near Coltishall.) is situated six miles south-east of North Walsham, about two miles north of Stalham, and less than two miles from the sea as the crow flies. The extent of the parish is 2494 acres, of which 303 acres were, in 1810, allotted to the poor, and were subsequently enclosed and drained. Exclusive of ditches, fences, and roads, there are 296½ acres of pasture, bog, and furze ground, and 1¼ acres of arable land. Previous to 1810 there were 7 falgates, 23 public roads, 10 private roads, 6 footpaths, and one public bridle path and footway in the parish.

Lands awarded to the poor during the opening years of the 19th century were not generally the most fertile in the district from an agricultural point of view, but for this very reason they now frequently prove to be most attractive to the nature-student. Having remained uncultivated, they retain many forms of wild life which have long been banished from other parts of the parish in which they are situated.

The poverty of common lands, from an agriculturalist's standpoint, arises generally from two extreme causes: lack of water, resulting in scanty vegetation and little humus in the soil on the one hand, or a plethora of moisture and an accumulation of peat on the other. These two extremes are to be found in close proximity on E. Ruston Common.

The parish gravel pit and the parish turf diggings (which fifty years ago supplied the chief fuel burnt in every house hereabouts) are within a stone's throw of one another. The marsh is but little, and the high ground about 25 feet above sea level.

Two flint Axeheads have been found in the parish within recent years by Mr. W. S. Horne, but the only local fossils that I have seen are large and small specimens of Echinus, Sea Urchins, or "Fairy loaves." These, however, may have been brought from the coast, as all the roads hereabouts have from time immemorial been partly and foolishly mended with sea gravel, the natural ballast of our fast disappearing beach.

In the Inclosure Act, an antique boundary stone, called "Lata petra," is mentioned. A reminder of the Window Tax remains at the Manor Farm, where a latticed ventilator and light admitter (through which a "Pick Cheese," *Parus ceruleus*, could enter) still bears the superscription of: "Cheese Room." The Vicar of Ruston has a Swan right, as shown by the ancient county Swan Roll.

The population of the parish was 516 in 1808; by 1851 it had risen to 845, falling to 603 in 1901, thus showing an

increase subsequent to the Inclosure Act, and an increase slightly higher in proportion to the county increase during same period, and a decrease during the agricultural depression at a later date.

The number and size of the churches in the district, and their frequently isolated position with respect to the houses, suggests not only that the district was once much more thickly populated than at present, but also that the houses which now at Ruston cluster around the Common lands, have moved away from the churches. Seldom, however, are any remains of ancient dwellings discovered, but this may be accounted for by the fact that in ancient times cottages were usually constructed out of far less enduring materials than are the most jerry-built houses of the present day. Several "clay-lumps" (cottages with mud and wood walls, and thatched or turf-clad roofs) have crumbled to decay on Ruston holmes, within the past quarter of a century, and left no trace of foundations behind them.

In their award, under the Inclosure Act of 1810, the Commissioners ordered the erection of sixteen new gates, with posts, rails, planks, and stiles where necessary; the making of banks by the road sides, from the earth thrown out of ditches, which were to be four feet wide at the top and three feet deep. These fences were to be planted with whitethorn layer, which was to be protected by half-hurdles or thorns, which were to be set on the top of such banks, and to be kept in good repair for the next seven years. As a further protection of the thorn hedge, no stock were to be allowed to graze the roadside-herbage for the six succeeding years. The fen, or low ground, was to be divided or separated by water dykes, nine feet wide at the top, and four and a half feet at the bottom, by five feet deep. The work of inclosure was to be completed within three calendar months.

Instead of inclosure, and the changes that accompanied it, producing rural depopulation here, and as has been said of

other places "converting the villager from a peasant with a mediæval status to an agricultural labourer entirely dependent upon a weekly wage," population, as we have seen, increased, and the villager's status was probably raised in consequence of the ability or opportunity of earning something additional in the actual work of inclosure, and the annual upkeep of the many new gates and posts, rails, bridges, planks, and stiles, and the mileage of fences, ditches and dykes to be yearly brushed and drawn or bottom-fyed, together with the increased money to be earned by the more intense cultivation of adjacent lands allotted to private individuals. In the present case, moreover, we are chiefly dealing, not with the inclosing of waste land and common fields and the awarding of them to separate owners, but with the inclosing of large tracts of Poor's land for the benefit of the poor. It has been calculated that the cost of survey and allotment was (as a general rule) abour £1 per acre, and the cost of enclosure quite half as much again. The Ruston Common Inclosure Act left the peasant with a well-drained and well-fenced common in perpetuity, an inclosure which is, even at the present day, the envy of all neighbouring parishes whose commons are not thus protected, and which are, therefore, a constant source of trouble in consequence of gipsy encampments thereupon.

Printed handbills, circulated in 1832, '45, '53, and '67, prove that the rules and regulations concerning the common were not only sensible and well considered, but also strictly enforced by the Trustees, who, to my own knowledge, have, for the last thirty years at least, taken much interest in the fair administration of their trust.

As to the inhabitants, higher education, and the advent of school teachers from other counties, have, of course, tended towards the obliteration of local dialect, and robbed the rising generation of implicit belief in many articles of mythical creed and former day folklore—but old faiths and practices die hard.

Ancient distrust for strangers, and contempt of men "from the shires," has indeed almost vanished, but the older Ruston folk certainly retain in part the Bœotian reticence and indefiniteness for which the inhabitants of the district were formerly famed. They "don't mind if they do," when invited to partake of something that they greatly desire, and speak of "several" only, when they mean, perhaps, hundreds.

Information concerning the sayings and doings of the past is difficult to extract from the ancestral type of commoners, but much might still be written about the curious things that are believed in and done by them in secret.

A tale was widely circulated here a few years ago, which redounds creditably to the wit of a Ruston lass. She was leading a Donkey to or from the common, and was met on the road by a visitor from London. He, on chaff intent, enquired whether she would sell her Donkey, to which she promptly replied: "Lor, bor, dew yow think yar father can afford ter keep two?"

Fried Mice are still administered to children for whooping cough, and Hodmadods (or Snails) are prescribed for consumption. Tom Breezer, the Dragon Fly, is captured to bite and cure writs (or warts). Two or three items of Scatology are practised. Lucky days are observed for sowing seeds. To dry off a cow, a libation is made to the Gods by milking her on to the ground. The evil eye of an offended woman has been supposed to afflict local cattle during the present year; and within the past decade I buried a woman who died (as I afterwards heard) with a fiddle string tied round her middle to ward off the Evil Spirits! The last Jack o' Lantern that was reported to me appeared on Ruston Holmes in October, 1890; but the old idea of a Frog or Toad living and growing within for months after having been swallowed by a human being, was supposed to have been exemplified in a Ruston boy who swallowed a "Fresher" for fun last

summer, and neither his victuals nor two doctors could do him any good! "Fresher," I may say, is the local name for a young Frog; Tadpoles we call "Spotspoons."

The attachment of the inhabitants of low lying districts especially, to the land of their birth, was long ago proverbial, The people of Ruston still uphold this reputation. Present day family names may be traced back for many generations in the parish registers, but there are no longer any descendants of Porson, who was church clerk here for over forty years, and whose gifted son (after being sent to Eton by his patron, Mr. Norris of Witton) rose to the high position of Professor of Greek at the University of Cambridge in 1803.

I do not remember a case of ague, but I buried an old Ruston woman last month whose countenance bore the specific yellow tinge of that once prevalent complaint; escape from which caused the late Col. Hawker, of punt gun fame, to render thanks to God on safely leaving what he called, in 1815, our pestilential climate.

The oldest Ruston parishioner seems to have been Widow Helsdon, who died in 1803, aged 105 years and 11 months, after having lived in three centuries. She left a numerous progeny of nearly eighty persons, including several great-great-grandchildren. Elizabeth Bates died here in her 99th year in 1894. The present church clerk, E. Gaze, has been in office all but fifty years.

The longevity of the poorer people, and their ability to wreak a bare subsistence from the many commons in the Smallburgh Union, supplemented by "taking of the parish," may partly account for the money now spent here in out-door relief being nearly the highest of any district in England.

As a member of the Board of Guardians, I may, however, thankfully say that our policy has not been to destroy the liberty of the needy by forcing them into the House.

Large families are the general rule, and there has been

much intermarriage. Some lads "follow the sea," but since the introduction of steam trawlers, the fishing is not what it used to be.

A good many young people from Ruston have emigrated, not to our colonies, but to the U.S.A., round about Medina where there is a regular colony of Norfolk Broadlanders.

When the Eastern and Midlands Railway first opened up this district, it used to be called the Goose and Donkey Line: but whether on account of the number of commons through which it passed between Lynn and Yarmouth, or on account of the simplicity of its local passengers, or the patience of its officials, history does not relate. The various railways must have brought coal very opportunely to many country districts where the local supply of wood on the one hand, and of peat on the other, was rapidly being exhausted: and especially to those inland parishes which had no adjacent waterways for the conveyance and distribution of fuel. Ruston had its parish staithe on the river Ant before the present Dilham canal was constructed, but in spite of this, and the proximity of the parish to the coast, where (in the neighbouring parish of Walcot) much coal and other commodities used to be landed, the natural products of the common were at one time more absolutely necessary than they are now even useful, to its inhabitants. Not only did the rushes which grew there once form the wicks for the only candles then made, but they afforded also the primitive carpets of the clay-floored cottages, before they were paved with brick and strewn with sand. The Furze bushes provided kindling for the peat fires, as well as material for effectually walling in the cattle sheds; and the upland turf supplied the place of the present day slates and tiles for roofing purposes—not only for outhouses (as some are used to-day), but they also were used in place of, or in addition to, the thatch covering of cottages.

Let me now give you a short digest of the Bye-laws made

by the Trustees of the common from time to time, so far as I have been able to trace them.

Taking the Peat digging, or Hover cutting, first, the date for commencing cutting in 1832 (the earliest year that I can find any reference to), was May 8th, at 2 p.m., and none were to be cut after July 15th. No part of that common called the Southfen was to be cut for fuel, it all being Smee, Smeath, or smooth feeding ground.

People allowed to benefit by common rights were those not occupying tenements of more than £5 yearly value, or more than ten acres of land. Any common holder, who was unable to act for himself, was allowed to appoint some one else to cut for him.

When cut and partly dried, the hovers were to be arranged in stacks, six yards long by one yard wide and two yards high, or 216 square yards for 1000 hovers.

5000 hovers was the maximum number allowed to be cut by each common holder. This, at 1s. a hundred, the price that dried hovers were sold at, would give 50s. worth of fuel, to last a cottager for the year—allowing just over thirteen hovers to be burnt per day—rather more than was required, I am told.

If the doing was good, a man could cut 100 hovers in five minutes. Two men, still living, are known to have done this.

The old fashioned ovens in which bread was baked by hovers had a chamber above, as well as below, into which burning peat was put, so as to bake and colour the loaves at the top as well as at the bottom. The base of the top chamber was convex. This gave more heat to the sides of the ovens, and allowed room for loaves to rise higher in the centre.

The only printed account of Norfolk peat cutting that I have seen describes the hovers as being four inches square, each square foot of peat producing nine hovers, each yard 81, and each acre 392,000. At 1s. per 100 this would make an acre of hover ground worth £196. But no present inhabitant of

Ruston can remember the hovers being cut to any special or uniform size, although there must have been some regularity in their dimensions, for, as I have said, the space of ground that 1000 should occupy was definitely laid down in the Trustees' regulations. The tools used in cutting the hovers differed a little in size and shape, the width of the spade being from 6½ to 7½ inches, and the depth 5 to 7 inches, the blade was either heart—or shield—shaped. The wooden cot or tee handle was fixed at a slight angle to the blade.

The following dates were set for the inspection of fuel by the Trustees: July 20th and 30th, August 4th, September 17th and 28th, and October 10th, beginning each day at the Town house at 7 a.m., proceeding to the gravel pit (9—11 a.m.), Fox Hill Common at 1 p.m., Long Common 4 p.m., finishing at the Holmes at five o'clock in the evening. A good long day's work, showing how much peat was cut here seventy years ago. All fuel was to be cleared by October 10th.

The following alterations and additions to the rules were made in 1845: Trustees were to attend in person at the commencement of the hover cutting, to see that each cutter had a fair start. No selling of hovers to other than poor inhabitants was to be allowed, the penalty being five years exclusion from cutting, and on repetition of the offence, total exclusion and prosecution. We here get a suggestion of the Trustees' fear that the peat was being too rapidly worked out. Parishioners who were assessed at less than £2 were not to be now allowed to exercise common rights. This was mentioned again in the handbill of 1853, but I can find no subsequent reference to it, and its object seems somewhat obscure, unless it was meant to exclude thriftless, casual inhabitants, or that householders only were to exercise common rights. If a nominee was appointed to cut hovers, he must be a parishioner, and his name must be given to the agent of the Trustees on the day previous to the commencement of cutting. One day only (the last Saturday in July),

instead of six days as previously, was appointed for the Trustees' inspection of fuel, commencing at Dyballs' Common at six instead of seven a.m., as heretofore, and proceeding to Barber's, New Bridge, Holmes, and Low Commons, which seems to indicate that by 1845 there were not nearly so many hovers cut as formerly. All fuel was to be cleared by November 5th instead of by October 10th.

In 1853 the maximum number of hovers was reduced from 5000 to 3500, showing that the Trustees still feared depletion. The inspection was deferred from six until eight a.m., and all fuel was to be cleared by November 30th, instead of the 5th ; what remained after that date was to be sold by the Trustees.

In 1867 the hover cutting was to be started on May 8th at two p.m. by the firing of a gun. The maximum number of hovers was now put back to 5000, from which we may gather either that the Trustees' fear of depletion was found to be groundless, or that not so many people as formerly availed themselves of the right of cutting hovers. Nominees for cutting were to be sanctioned in writing on May 7th between 9 a.m. and 1 o'clock by Mr. Ash Rudd, one cutter only for each common right. In 1880, May 1st, instead of May 8th, was appointed for hover cutting, as also in 1882, in the latter year commencing at 12 noon, instead of 2 p.m. as previously.

As to the cutting of Turves or upland or upground flags (then used for roofing, laying down lawns, inoculating pastures or banking, though some were burnt), these were to be cut from amongst the Furze bushes only. The date fixed for cutting, in 1832, was July 1st ; 1000 was the maximum and none were to be sold out of the parish.

They were to be stacked for inspection, in 100 or half 100 heaps. In 1845, the date of cutting them was altered, and was to be from June 1st to August 1st. In 1853, all were to be stacked by July 29th. The tools used for cutting them

were shield-shaped, the blade was ten to eleven inches wide, by about eight inches long, and the handle was placed at a greater angle than in the hover spades.

As to the Cutting of Furze.

The rules for 1832 appointed six score faggots as the limit, and these were to be cut between October 1st and March 31st. In 1845 the time was reduced, and one month only allowed, namely: September 1st to October 1st. The overplus of fuel of any kind was not allowed to be removed by the cutters thereof, but was to be sold by the Trustees, and not removed until paid for. In 1853 the maximum was reduced to three score faggots, but the time for cutting them prolonged by a month. In 1867 a rule was made that no Furze or Thorns were to be cut from the fences, without the special consent of the Trustees.

The Grass, Rush, or Fodder cutting, was fixed in 1832 to commence at 8 a.m. on July 20th. In 1867 it was to stop on the last day of February following. In 1882 the time for commencing was changed to 6 a.m., and none was to be cut between January 1st and July 20th. In 1875 a parishioner was fined for cutting before time—there had been one similar previous conviction in 1862.

Now as to the Grazing.

In 1867 the following rules and regulations were in force and have not been repealed. Each holder of a common right was allowed to turn on to the common:

3 Head of Stock and no Donkey or Geese, or
2 Head of Stock and 1 Donkey and her Foal, or
1 Head of Stock and 2 Geese with their broods, or
5 Brood Geese, Gander and Goslings, with 1 Donkey, and her Foal.

This is the first provision made in any printed handbill

for a Gander on the common, and I can find no reference to a Stallion Donkey, Pony or Horse, or a Bull, but an unwritten law forbids either being turned on to the common.

Since 1832 no Pigs have been allowed to be turned out, nor any Stock which were not kept on the premises of the claimants. Nor must any dung or soil be removed, or any fences cut. A Pinder was appointed in 1845, he was to report all breaches of rules to the Trustees, impound all Stock and Geese above regulation numbers, and levy such rates as were necessary.

In 1893, the Trustees applied to the Charity Commissioners to draw up a scheme for the management of the common. They ordered that the funds in the hands of the Trustees, amounting to £203 19s. 5d., should be invested, that all the proper expenses incidental to the upkeep of the common were to be a first charge on the income of the Trustees, the remainder to be spent in various charitable ways suggested by them, but left to the discreet selection of the Trustees. The Commissioners recognised the right of the Trustees to let the shooting, but made no reference to the grazing, or fuel, or grass cutting, leaving the beneficiaries thereof as under the Inclosure Act of 1810.

No mention (as far as I have been able to discover) is made in any of the rules and regulations concerning the ancient custom of gathering Rushes for candle wicks, although this was once a great and apparently highly remunerative local industry; and so much in request were Ruston candle rushes, that women from other parishes used, within the past fifty years, to resort hither to gather them. A certain Mrs. Cutting, of Happisburgh, is said to have made £10 from her rush harvest, and another woman from Hickling was an adept at the art. After the rushes were carefully pulled, or drawn separately, by hand, they were heaped, preferably, in a dry ditch until they became "clung," *i.e.*, had lost their natural stiffness. They were then, with a small

knife, peeled of their outside green skin, with the exception of a small strip of rind on either side, which was left to give rigidity to the soft, white pith. They were then dried in the sun, packed into so many bunches to form a bundle, and sold at Norwich Rush Fair on the first Monday in August at about ten shillings per gross.

When peeled, twelve rushes were tied up together to form what was called a whip, and twelve whips went to a dozen, twelve dozen whips made a gross, that is, 1728 rushes—or what haberdashers would call a great gross. The rushes were very neatly bunched up, into the form of elongated cones, standing from 3½ to 4 feet high. The cones measuring at the base 30 to 36 inches in circumference. In 1875 one thousand dozen Rush Candles were sold by one grocer in Stalham. These were made in different sizes. The late John Bayles of Ludham used to light up his shop with "middle eights," and it was the duty of an apprentice at his grocery stores, for the first winter of his apprenticeship, to see that these candles were properly "snuffed," and to snuff one or two out, when the absence of customers did not warrant a great expenditure of tallow!

In hot weather it was not an uncommon thing for the tallow to drip on to the customers whilst they were doing their shopping.

The Rush Fair was held at the Artichoke Inn, near Magdalen Gates, Norwich, and was looked upon as a regular jollification by the people of this neighbourhood, who took or sent up, cartloads of future candlewicks.

Ruston may be a corruption of Rush town. The Sweet-Sedge (*A. calamus*) does not grow here, and I have not found it nearer to Ruston than by the river side between Sutton and Catfield to the south-east, and at Westwick to the west, but it was probably planted artificially round the lake at the latter place. Within the past ten years strangers have visited Ruston Common, for days together, searching for large

Furze stems for making walking sticks and umbrella handles for sale.

As to the present management of the common, although the same Bye-laws of the Trustees are supposed to be in force, as were submitted to the Charity Commissioners in 1893, the slump in peat as fuel, and of furze for kindling, since the old specially constructed iron, large brick ovens and open chimneys have entirely disappeared, has resulted in their being less rigidly enforced. Fodder cutting, however, still commences at 8 a.m. on July 20th; and this annual grass mowing is well observed, since even if only fit for litter, rushes and mixed stuff are always saleable in this bullock grazing district. The date of hover cutting is May 1st, commencing at twelve noon, but little notice is taken of it; peat burning having become practically obsolete. Upground flags may be cut from June 1st to August 1st. Few only now are used for roofing or covering beehives.

Furze may be cut during the month of September; but in point of fact, more is cut during the winter months. Children still go sticking amongst the gorse bushes on Saturdays. No gravel is cast from the parish pit for mending the roads, which are now taken over by the County and District Councils, but any parishioner can claim any amount of sand, silt, gravel, or stone on payment of one penny per horse load. The gravel is of good colour, but will not bind. None is supposed to be taken out of the parish, nor any upland flags, though fodder or litter, furze and hovers may now be so disposed of.

There are no longer any restrictions as to the quantity of hovers, turf, or furze allowed to each commoner, nor as to the number of stock or Geese, nor apparently to the amount for which their owners are assessed. The poor are too poor to buy a Cow, and the grazing would be wasted if those who ought not did not make use of it. It is a question, and a very interesting and important one, whether the rules of the Charity Commissioners are wide enough to allow the Trustees

to assist or advance money for the purchasing of such stock. The regulation as to the non-removal of dung or soil from the common is still in force

There are some few stunted Alder and Sallow bushes on parts of the common, but no law has ever been made as to the cutting of these for peasticks, &c., and no buildings are supposed to be erected on the common, but a few fowl-houses are in evidence.

The best parts of the common for grazing purposes are now being much encroached upon by the spreading of the furze, and one wonders that concerted action has not been taken to control, within reasonable limits, this gatherer of atmospheric nitrogen, but smotherer of pasturage. There are not enough Donkeys to nibble down the gorse bushes, and, except during deep snow, Rabbits only destroy isolated seedlings, ere spines replace the trefoil-like foliage of the first year's growth. Occasionally, severe winters, with salt laden winds from the north and east, kill back the straggling tops of the taller bushes, and now and then a fire, accidental or otherwise, blackens and denudes certain portions of the common. It is a curious fact that the narrow-leaved Willow Herb (*E. angustifolium*), the fire flower of the American prairies, cropped up here after several acres were burnt during the winter of 1901.

A rough census of the stock in the hands of those who are legally, and on sufferance, graziers of the common, taken last week, works out as follows: About 230 brood Geese, 46 Donkeys, 57 Horses and Ponies, 30 Cows, 18 young cattle, and three or four Goats. This suggests what the common might support if cleared greatly of furze, and how beneficial it might be to the poor if only they had Cows; but practically, all the stock that now graze the herbage, with the exception of the Geese, Donkeys, and Goats, belong to parishioners who are assessed at above £10, and, therefore, have no legal common rights.

There has never been any specified time for turning stock out on to or for taking them off the common; pasturage is free to all commoners throughout the year. Worstead Fair Day, May 12th, is the generally received day hereabouts for first leaving out at night such cattle as have been housed during the winter months. The only remaining vestige of allotments, or severals, occurs during the grass mowing. It then falls to the lot of the first man on the common after the appointed time for commencement to select where he shall mow, and having made his choice, no one interferes with him. With respect to the hover cutting, Mr. J. T. Hotblack informs me that a man could dig peat for the year from as much ground as he could mark out with his spade without coming into contact with any other person who was meanwhile occupied in defining a similar zone for his own sphere of labour.

The first record that I can find of the shooting on the common being let, was in 1853, when it fetched £2 2s. 6d. The average annual rent, up to 1870, was £3 5s. In 1875 the Trustees resorted to public auction, the result being that the right of shooting from November 4th in that year to August 31st, 1876, was knocked down at North Walsham for no less than £25. The idea of fixing the last day of August for the termination of the tenancy being, to give the lessee the opportunity of making up a chance bad beginning of the season with a good ending.

The publicity of public auction acted as a good advertisement, attracting further competition from afar, and in 1891 we come to the record price of £54, which must be accounted for by the fact of the tenants of the adjacent game preserves at Horning and Crostwight thinking that many of their Pheasants fell to the share of the Ruston Snipe shooters. From that time, however, to the present season, the average annual rental has fallen to about £25. Since 1903 the expiration of the yearly tenancy has been changed from

August 31st to March 1st, the then lessee (Com. Rogers, R.N.) voluntarily surrendering his rights upon the latter date for the benefit of the following year's sport. Private tender was substituted for public auction in 1896, and this gave rise to a question which was not submitted to counsel: one bidder offering in his tender to give "a pound more than anybody else." Query, was this eager, cunning, would-be hirer's offer a legal tender?

As I have said, the total extent of the common is about 300 acres, of which a little more than half is Snipe ground, the remainder being comparatively high and dry, and more or less closely covered with furze bushes.

When the water is right, and the litter is well cut, Ruston Common is still very attractive to Snipe, both Jack and Full. At the opening of the season, the amount of sport to be obtained, depends of course upon the number that are locally bred; but these all depart before the end of September, as a general rule. The few Redshank and Common Plover that are bred here take their broods away before the end of August.

The record bag, as far as I have been able to ascertain, is 41 couples, made by six guns, in October, 1878. Robert Pye, the late host of the Butchers' Arms, who either hired or managed the shooting for many years, told me that he one morning killed 47 Woodpigeons here before breakfast, and 84 Wildfowl in a single week, feeding them with brewer's grains during the hard weather of 1881.

Distance is apt to lend enlargement to the former size of sportsmen's bags, and I have been unable to verify the reports of much former slaughter of Snipes on Ruston Fen. I have looked carefully through the carefully kept memoranda of the late Ash Rudd, J.P., who lived in the parish and was an excellent Snipe shot, once killing fourteen without a miss. He shot on the common and on his own adjoining marshes more or less frequently from 1857-1880, keeping

a record of his own and his companions' doings meanwhile, but I find that his best day was only 15 couple, and 25 of them were Jacks. I was also surprised to find that the diaries of the late Rev. S. N. Micklewaite disclosed nothing over 12 couples as shot by himself or friends in a day at Hickling. Larger bags than these, however, were being made about the same time by the Waites at Hempstead, and in 1868 my father killed 33 couple in a day to his own gun at Somerton. On September 28th, in the same year, Mr. Ash Rudd and Mr. F. Hylton killed 27½ couple on Ruston Fen, but one couple only of them were Full Snipe; the Jacks had probably just arrived from over sea. The heaviest weights recorded here by Mr. Rudd are 6 ozs. and 6¼ ozs., shot on November 3rd and 8th, 1880.

When the weather is very mild, Snipe occasionally drum during the winter, usually at evening twilight. I have notes of hearing them in December and January. Several Solitary Snipe have been killed on the common. 1887 was a great year for them, no less than five being shot here.

Common Lapwings relying more especially upon the adjacent arable lands for a living, seem to be more susceptible than Snipe to atmospheric changes, and generally leave us in the winter before the actual advent of severe weather. For instance, we had more of these useful birds about here last November than for several previous seasons, but by about the middle of December, the bulk of them had taken their departure, and thus escaped the sharp frosts with which the year ended. So long as open weather continues, they feed chiefly on the ploughed land and stubbles by day, but regularly resort to the marshes at night to drink and to wash their feet and beaks after their slug and worm hunting.

There are at least three good stands for flighting Duck on the common, each place sufficiently far apart from the other as to admit of being visited by the sportsman two evenings

in the week without unduly frightening the fowl. Light oats are the best corn to feed with, as they float attractively, and a live and tame decoy Duck pegged down early in the evening within range is conducive to sport. There are two directions from which Ducks come in to feed at night-fall, one from the east, by which those fowl travel that have been spending the day on the sea, the other from the south, which is used by a smaller number of fowl which have passed the day on or around the inland broads.

Mallard, Wigeon, and Teal, with now and then a Shoveller, may be met with from October to April, and a few pair of Wild Duck breed here. In wet and open winters, large quantities of Lapwings are to be seen, and one part of the Common is specially attractive to Wild Geese, the white-fronted being the most likely species to be met with. There are certain spots specially beloved by each species of Wildfowl or Wader.

The ground requires knowing, not only for the purpose of seeing the various birds, but also for comfort and security in walking, for though the soft peat and mossy beds have generally a hard bottom some three feet down, there are many dangerous holes capable of giving the unwary or inexperienced traveller a far deeper ducking!

An unusual feature in this shooting, compared with that round the Broads, is the fact that Ruston Common can boast of two running ditches which seldom freeze entirely, except in the very hardest winters; and these two ditches, one on the Honing and the other on the Brunstead boundary, are of sufficient length to afford a full day's shooting. There are also certain swampy spots on the fen, where the water is highly charged with iron (that old sulphur, as it is hereabouts called); these, too, seldom freeze, and are, consequently, much frequented by the Longbills when all around is ice clad.

The former extensive annual peat digging acted in two different ways upon Snipe: the locally breeding birds were disturbed more then than now by the greater amount of traffic on the common, but by the digging out of the peat, fresh ground used to be annually exposed, from which the winter migrants could feed.

In February, 1888, I made a goose of myself over a Ruston Common Gander. The ground was covered with snow, it was "regular wildfowl weather"; my man sent in word, asking if he could have my gun, as a Wild Goose had just alighted in the field at the back of the house. Lone fowl being generally comparatively easy of approach, I thought I might as well take the gun myself, and hastened to do so; meanwhile, the Goose had risen and flown across Ruston long common, and settled down out of gunshot from any covert. On my attempting to stalk him, he rose again, circled round, and dropped within some seventy yards of a fence. Having safely gained that ambush, I drew a bead upon his neck, one pellet severed the spinal cord, and the great grey bird was mine! Once in hand I could not identify him with any wild species, but held my own counsel. After a few days hanging, I was in the very act of carrying him to be plucked for cooking, when a ring came to the front door bell, which I answered in person, bird in hand, to be greeted with: "Please, sir, you ha' shot my gander," to which I replied: "Yes, bor, I am sorry to say I believe I have! You are just in time to have him, or half a sovereign—which you like." The man said: "Please, sir, I'll take ther monner." But I was not to be let off thus easily. Long afterwards the soft impeachment greeted me by road and rail: "Who shot the Gander?" After this personal and practical experience, I learnt that tame Geese, and especially birds of the year, frequently take wing, on being let out of a morning, at their first sight of snow-clad ground.

As to the Chief Products of the Common.

Ruston has long been celebrated for its fast trotting Donkeys. Spending its youthful years in the constant company of Horses, whose speed it meanwhile strives to emulate, is generally supposed to improve a Donkey's paces. Parishioner Nockells once told me that he had frequently driven his impatient Ass to Norwich—over twenty miles that is—within two hours, and that without carrying either whip or stick. He and a friend driving a pair of Donkeys often passed the Yarmouth coach, which running from Sutton, used to be driven on alternate days by a woman. To drive a Pony in place of a Donkey was formerly looked upon as a sure and certain sign of a commoner's increasing prosperity. The number of local Donkeys has certainly decreased within the past twenty years, but as neither Ponies, Horses, or Cows have concurrently multiplied, it must be left as an open question whether the parishioners of Ruston are better or worse off than their forefathers.

As the Eastern origin of the species might lead us to expect, Ruston Donkeys restrict themselves entirely to the high and dry parts of the common, seeking food and shelter from the close cropped though luxuriant furze bushes. They are as careful as Cats about needlessly wetting their feet: but one would have thought that after having been born and bred for very many generations in such close proximity to water, the local representatives would long ago have disinherited themselves from all such antique racial antipathies: but only last year I heard of a Dickey driver, who, on his way home from work in a neighbouring parish, was obliged to unyoke and drag cart and animal through a big puddle on a tempest-flooded road. The predilection of these hardy animals for thistles is proverbial, their liking for Mares' tails (*Equisetum*) I have not seen alluded to in print. In spite of living Donkeys being such common objects of the

country, a dead Ass is seldom to be seen, and their age limit is uncertain. In 1905 I saw one which was known to be at least forty years old, though still in good fettle, very rotund, and apt to shy badly on the road. A thirty-eight-year-old Pony still does an occasional journey of some three or four miles between Stalham and Palling.

During the heat of summer, some of the few Cows which are kept on the common, may, during hot weather, frequently be seen standing assembled for hours together, knee deep in mud and water, chewing the cud, and flicking their tails at foraging flies. Some Cow-keepers say that this prolonged paddling spoils the quality of the milk; it undoubtedly conduces to coolness and comfort, and may act deterrently upon some species of insect foes. I have a note about watching a family of Wagtails acting as attendant Gnat or Fly catchers to wading Cows, and a pretty sight it was, there being scarce room for the long tails of the small birds above the water line, as they every now and again hovered to snatch an insect from the lower part of the Cows' bodies. Ducks also meanwhile gather round the Cows for a similar purpose.

Although the number of Geese annually reared on the common is considerably less than what it was some fifty years ago, the Gosherd is still with us. A good Goose is still expected to lay by Candlemas Day, and round about the anniversary of St. Valentine women may frequently be encountered on the road, handkerchief on head, and stick in hand, driving their Geese to or from the common. Incubation lasts about twenty-eight days. A Goose should never be set when the wind is in the east. Goslings generally appear about the same time of year as the Palm, or downy Sallow Catkins, begin to burst, and for their delectation beds of white turnip seed are thickly sown in autumn in the cottage gardens. Though their earliest food is composed of pills of yolk of egg and flour, Goslings are sold to the higglers when less than a month old for about two shillings apiece. What then becomes of them

is locally unknown; one prevalent tale, with which the simple cottagers are content, being, that for some special secret purpose the soft doom, or down, is carefully clipped from their tender skins, and their gelatinous bodies boiled down for cement—or mock turtle soup!

No Goose will lay more than one clutch of eggs until three years old, but it is a disputed question, though one would have thought an easily solved one, as to whether the earliest or the latest hatched clutches of Goslings prove to be double brooded in the following year. Certain it is, that where Geese graze persistently year after year, a short, close sward results; the coarser grasses, and such pasture pests as buttercups, are as entirely eradicated as Dandelions are eliminated by Hens, Ragwort by Sheep, and Plantains, Daisies, and Docks by Rabbits.

Some conspicuous and worthless weeds, such as Eyebright and Yellow Rattle, are, however, left untouched by Geese. The paucity of Reeds on Ruston Common is doubtless due to the browsing of cattle.

The influence of animals upon vegetation—the correlation of the Fauna and Flora of a district, is a wide and interesting subject. Some alien plants seem, in consequence, impossible of acclimatization in certain places. I have, for instance, made repeated though as yet futile attempts to introduce Wild Rice for Wild fowl, because of the Broadland Voles, and Giant Thistles proved as irresistible to the Marram-bank Rabbits. As to Geese spoiling the grazing for Cattle, which are popularly supposed to dislike feeding after them, I may say that I have, more than once, observed Cows devouring their droppings. Feeding on new wheat is supposed to encourage Geese to lay in early autumn, hence over-yeared birds should be kept away from stubbles and stacks at harvest time, for fear of their spoiling themselves for producing eggs in spring, since it is the earliest Goslings that fetch far and away the highest price.

Nettle seed and toast steeped in beer were formerly given to induce early laying. The record Goose's egg, so far as my own notes go, is 8 inches long, 15 inches in longitudinal circumference, weighing $15\frac{3}{4}$ ozs. The dropping of these large, double yolked eggs is hereditary, but it may sometimes result from over-feeding, or be due to atmospheric influence.

Brood Geese are given corn, maize generally now, but wheat or barley formerly, from about Christmas time. But, except during severe weather, whilst laying, sitting, or fattening, no corn is given to Geese. Like many other hard livers, they are also long lived (but they are only reckoned to be useful for twelve years). For distinguishing purposes, Geese are marked by having the membrane between their toes slit, or holes punctured therein; but as with the clipping of fishes' tails and fins, these punctured wounds, at least, grow up in time. Nature is a wonderful healer. I have marvellous specimens of natural joints of compound fractures in the leg and wing bones of Game and Wildfowl. A few years ago I shot a Hare in good condition which had had a copper wire snare so long and tightly wound round its hind legs, that the bones just above the heel had too firmly united for me to pull them apart, after I had removed the wire. In spite of which hindrance to its movements, I did not notice that there was anything radically wrong with this hare as she approached me in fairly thick covert, only discovering the ligature around her legs when picking her up. The supposed self-made bandages that one sometimes reads of as found round wounded birds' legs or wings are merely caused by the coagulated blood sticking to the body feathers whilst the bird is resting, and then, when the bird is suddenly alarmed, the effort to escape pulls the feathers from the body and they adhere to the wounded part.

The old saying, "To bed with the boys and the Goose to the fire, whoever gets into bed first shall have the leg," seems to suggest that only very old Geese—needing

a whole night's cooking—were anciently used for home consumption!

The furze ground on Ruston Common holds a few Hares, an occasional Woodcock, and many Rabbits, but the latter are very difficult to secure, in consequence of the young growth of the bushes being constantly browsed by Donkeys, the result being that they present an almost impenetrable exterior to any dog larger than the bunnies themselves; and it needs a dog of high courage to face the thick set prickly covert. I once took part in an enjoyable and fairly successful drive organised by the popular *pro tem.* lessee of the sporting rights. Every parishioner who owned a canine friend was invited to bring him out for a hunt, the nondescript pack of yelping curs performing their part better than we had anticipated; their owners were, perhaps, propitiated by a good lunch from poaching for a few Sundays following, and the hustled Rabbits gave very sporting shots as they rapidly dodged from bush to bush! Total bag to five guns: 33 Rabbits, 11 Hares, 3 Pheasants, 2 Snipe, and a Woodcock.

I have frequently seen the trail of Otters on the common after a fall of snow. Frost compels them not only to travel far from their usual haunts, but also, sometimes, to depart from their usual fare and attack poultry. A Canadian Goose was killed by an Otter at Westwick last winter. Long and severe winters sometimes result in Otters taking up their abode permanently in new localities, and thus fresh colonies are founded where an abundant food supply is found. Last winter I tracked an Otter that left foot-prints as large as those of a big Retriever. The claw marks are not so heavy and blunt as those made by a Dog, and on ice-clad ditches an Otter will visit each blow hole in search of fish, and the swish of his tail may every now and then be noticed on the snow, thus differentiating his tracks from those made by a Dog.

Harvest Mice (*Mus mussorius*) are found in local corn stacks, chiefly, or most numerously, in early spring, which

seems to suggest that they breed during the winter, though this is contrary to received ideas; and Short-tailed Voles and Long-tailed Field Mice are abundant, as are also Hedgehogs, Stoats (or Lobsters), and Weasels, or Mouse-hunters; but though I had two reports of Polecats being killed last year in the neighbourhood, a promised gratuity did not bring their dead bodies to me, and I believe the species to be locally extinct.

The rarest bird that I have heard of in connection with Ruston is a brown variety of the Common Snipe, shot by Mr. Ash Rudd.

The same gentleman had a good adult male Pied Flycatcher, which was killed by a Cat in his garden. On July 27th, 1889, I saw an almost white Redshank on Ruston Holmes.

Ruston common is a favourite haunt of the Spotted Rail, seldom an autumn passes without one being killed here; but they have not bred in the vicinity, to my knowledge, since 1889.

Ring Ouzels appear now and then in spring and autumn. Green Woodpeckers seem to have increased much in numbers during the past fifteen years, and from August onwards may often be seen searching the drier parts of the common for Ants' nests. Gaunt, grey Herons, too, may frequently be flushed from the marsh drains. Their nearest breeding places are Catfield Hall and Horning Grove, one nest each, Rollesby two or three nests, whilst at Gunton and Reedham there are old and well established heronries.

The unexpected happens as often in sport and nature-study as in the more serious affairs of life. The glorious uncertainty of what one may see in a country ramble adds zest to the search. Plant life, of course, is practically still life—a rare plant is for the time being immovable, and with the help of a local floral schedule, a botanist may predetermine fairly well as to what species of wild flowers he is likely to come across in any given district, but with the

ornithologist there is no such certainty. The bird list of any locality will include rare and occasional visitants, and even ordinary migrants, which may be here to-day and gone to-morrow. And herein lies one of the special charms of such a place as Ruston Common: one never knows what casual avian acquaintance may be made thereon.

My brother and I had been Snipe shooting here on December 5th, 1890, and were enjoying a mid-day rest and lunch amongst the sheltering furze bushes, when our attention was suddenly attracted by an aerial commotion above our heads—an immature White-tailed Eagle (*A. albicilla*) was being mobbed by a score or so of Rooks, the big bird lazily flapped on, making no apparent attempt at retaliation, or, at any rate, until he and his sable satellites were lost to our view amidst the stately oaks of Honing, about a quarter of a mile away.

Rooks and Crows are much given to thus making themselves obnoxious to birds larger than themselves: the latter species, however, often really mean business: thus, in January last, I saw two Grey Crows compel a Wild Duck—one out of several that I had flushed from Ruston holmes—to return to the water for safety. In March, 1888, two attacked a small liver and white Spaniel, whilst it was rolling in the snow on the common, and sent it back yapping to me with fright. The same day, whilst driving, I struck at a Crow with my whip, which was chasing a semi-starved Thrush.

A pair or two of Nightjars breed annually on the drier parts of the common. They arrive late in the spring, and seldom start their curious and monotonous churr-ing note until mid-June, sometimes keeping it up as late as the middle of August. The peculiarly liquid "quelping" note made by the male whilst chasing his mate I have not seen referred to in print. The well-known habit of perching lengthwise may be a protective device, rendering this beautifully vermiculated bird less conspicuous than if its long tail were

directed at a right-angle to the bough, or there may be some correlation here with the pectinated toe nail, which is more highly developed in the Nightjar than in any other British bird. Peculiar structural modifications, or appendages, in any animal have their explanation in the domestic economy of the species in which they occur. The long legs of the Crane-fly and Harvestman, the brush-like arrangement on the Glow-worm's tail, the powder-down tracts of the Heron, the palatal knob of the Bunting, the long hind claw of the Skylark, and the moustachial vibrissæ of the Nightjar are all as specially useful to their respective owners as is slime to the Snail, a prickly jacket to the Hedgehog, or tails and gills to the Tadpole, whilst a larger eye would be worse than useless to the underground Mole, and a shorter tail a dangerous defect to a Dormouse.

The popular fallacy that still, at least through its Latin name, connects the Nightjar with Goat sucking, is even more absurd than the idea of Hedgehogs sucking Cows—each wild thing merely being attracted by the lowlier creatures, insects or annelids, which hover around, or are frightened out of the ground by the grazing or recumbent quadrupeds.

During the winter months one often comes across small masses of an opaque, gelatinous substance lying on the banks of the ditches, or in swampy spots on the common, the identification of which has puzzled several scientific naturalists. In January, 1903, I sent some up to the R. H. Society; it was submitted to Dr. Cooke, the fungologist, who said that it closely resembled the fungus (Nostoc) which often appears after rain, but he could not identify it at all, and suggested my forwarding a specimen to some chemist.

I sent some to Dr. Nuttall of the Cambridge Laboratory: he conferred with Lister and Professor Marshall Ward, and reported: "The mass is chiefly composed of the capsular substance of an Alga, what appears to be a Nostoc, but a yeast has also been isolated from the mass. Besides this, I found

a variety of micro-organisms in the jelly—which is, consequently, not of animal origin." I next forwarded a sample to Mr. Balfour Browne whilst he was at the Sutton Laboratory, and he replied as follows : " I have occasionally found similar masses, and like you, have associated them with Frogs, believing—though without any good grounds—that they are the result of some disease in the reproductive organs of the females. These masses of jelly have not, so far as I have been able to find, any structure, and I dare say you have noticed that they have a 'froggy' smell. They are usually the haunt of large numbers of infusorians and unicellular algæ."

My own idea is that it is the imperfectly developed spawn left by Rats, or squeezed out by Herons, whilst feeding on hibernated Frogs. Fully developed Frog's spawn swells greatly in water after being naturally deposited, and the absorption of moisture may well account for the masses previously mentioned being sometimes as large as Ducks' eggs. On January 23rd, 1903, I found several pieces on the ice covering of a marsh ditch ; there were Heron's footprints on the snow around, but no mark of Rats' work. I may here say that the idea is prevalent amongst marshmen that Frogs " gum up their mouths in the winter time, and if you then force open their lips, they will die directly."

A curious fact in connection with the life history of the Frog, is the fact that their singing generally takes place after, and not, as is the case with birds, at or before the breeding season. For instance, in 1907 I found Frog spawn during the third week in March, but did not hear their croaking chorus until the second week in May. This music—which is sometimes continued into July—has given Frogs the local name of " March birds " : this may be a corruption of " Marsh birds," at any rate, the latter is the more appropriate, for it is very seldom indeed that Frogs or Toads are heard to croak hereabouts in the month of March, although Gilbert White

gives February 25th as his earliest date for hearing them croak, and February 28th as the earliest for having seen their spawn, with March 22nd as his latest date during twenty-five years' observation. Markwick, in his earliest and latest notes on both events, puts the croaking at an average of about three weeks after the spawning.

There are one or two colonies of Natterjack or running Toads in Ruston, but I have not heard of the Edible Frog being found here, although it has been taken in the adjoining parish of Brunstead. All three species of Newts occur, and also the Slow Worm and Sand Lizard. Vipers abound, and are chiefly to be seen, whilst sunning themselves, in the early spring, before vegetation has grown sufficiently to conceal them. The flickering of the bifurcated tongue of the anxious mother probably deceives as well as attracts the attention of the casual onlooker whilst the scuttling Viperlings are secreting themselves amongst the adjacent herbage; and this constant action of the disturbed parent may account for the theory of her protectively swallowing her young when danger threatens them. That new born Vipers are well able to look after their own interests the following tale will prove: A few years ago I was walking with several other members of the Eastern Sewers Commission, across Horsey warren, when one of our party suddenly threw up his arms and cried out: "A Snake, a Snake!" I sought around, and soon discovered a large gravid Viper, which I killed and commenced to dissect on the spot, soon liberating several young ones, which were sufficiently well developed and lively to strike so maliciously at my shut-knife, that the bystanders cautiously cried out: "Mind they don't bite you."

Cats seem to attack vipers without receiving hurt. I have heard of them bringing Vipers into Ruston cottages. R. Vincent, defendant in the late Hickling Broad case, will pick up a Viper by its tail, quickly flip it whip fashion, and so disjoint the vertebra at the neck, that the head flies off

in the process. The Ringed Snake does not occur here. Some years ago a Tortoise was thrown out of a Ruston Marsh ditch by a man who was bottom-fying. or dyke drawing, and on July 23rd. 1906, Miss Green of Belaugh caught a Water Tortoise at Wroxham. I had one brought to me from Potter Heigham a few years previously, but discovered, subsequently, that it had made its first acquaintance with Norfolk on a Yarmouth hawker's barrow! Mr. Balfour Browne writes of one (see our Trans. vol. vii. p. 754) as found at Ludham on Feb. 19th. 1904.

There is a local idea that thirty years ago no Moles were to be met with on the common. In 1887 an ancient inhabitant drew my attention to numerous grass-covered hillocks on the South Fen, and asked me what they were. Old Mole heaps, I suggested, whereupon he said that he had never seen the work of one on the common. They are frequent enough now, on the drier parts, and the generally received idea is that they came with and by the railway! The truth probably being that, in former days they were well and regularly killed down in the parish.

When the lower parts of the common are first flooded by autumnal rains, many Glow-worm larvæ are washed out. In October and November, 1889 I found hundreds thus stranded at high-water mark, but I have never hereabouts happened with a really bright female in the perfect stage. The large Water Beetle (*Dytiscus marginalis*) may frequently be found, and the Brimstone Butterfly is a common spring insect, though its food plant—Buckthorn—does not actually grow in the parish. The regular mowing and feeding of the common are not conducive to the seeding of the larger umbelliferæ, hence we have no really local specimens of the Swallow-tailed Butterfly.

A smattering of botany is an aid to comfort if not to success in Snipe shooting, as a knowledge of the habits, or rather habitats, of the more frequent marsh plants will often save

the bog-trotter from getting his boots full of water; and by boots, I may say that we mean, locally, "boots *par excellence,*" crotch boots, without which the peat beds cannot, of course, be crossed in winter. Sedges generally grow upon a firmer bottom than many of the rushes. An expanse on which the Potentilla-like leaves of the Marsh Cinquefoil are conspicuous, and also beds of Sphagnum. may be usually trodden upon without hesitation, so long as one avoids the tiny pools of clear water wherein nothing apparently grows. Walking over floating or semi-submerged bogs, when one foot goes down deeper directly the other is taken up for the next step, is rather trying to the nerves of the novice, and a zig-zagging Jack Snipe is as likely to be missed under such conditions, as a wild-rising Frenchman is apt to escape the best intentions of a tired sportsman when walking across the ringes of a thick piece of Swedes at the end of a hot September day. As to walking on ice, "crack she bears, and bend she breaks," is a safe though rather alarming rule to follow! Open slads of water, the clear bottoms of which are covered with Chara, are trustworthy walking, but isolated patches of stunted reed should be looked upon as danger signals, and also small clumps of Reed Mace (*Typha latifolia*). The Yellow Iris, when in large masses and growing as it sometimes does as a floating aquatic, makes so hard and closely compacted a root growth as to support the careful walker. Where the going is at all uncertain, the great thing is not to hesitate on one leg, or "put one's false weight" upon one foot, or dwell between one's steps, and also to plant one's feet not parallel with, but at an angle to the body, so as to avoid breaking through the crust of vegetation with points of toe or heel. It may be only a curious coincidence, but it is a fact that I have often noticed (once at Wroxham, three cases in one day), that when one does go in, it is generally with the left leg. The habitat of the true Bulrush (*Scirpus lacustris*) is never walkable, as it

delights in a deep and soft mud bottom. We, locally, are a bit mixed in the names we give to this and several other bog plants. *S. lacustris* we call Collar Gladden, because it was formerly much used for the manufacture of rush horse collars, and chair bottoms were formed of it. The Reed Mace, which is also used for the same purpose, we call "Gladden bushes," whilst growing *en masse*, and Boulders when in bloom. The Yellow Iris, a nearer relative to the true Gladden, we call "Flags." *Schœnus nigricans* used to be commonly known as Black Star when it was in vogue for stitching the fore-mentioned soft rush horse collars. It grows on a solid bottom, and so is a safe guide to the Snipe shooter, as are also Pin rushes (*Juncus communis vel effusus*); the pith of which formed the wick of former day rushlights. There are still a few old stagers living in the parish who can remember gathering them for this purpose.

There is an old and a true saying that a wet year is a Rat year, and a dry year is a Rabbit year. The ubiquitous brown Rat is practically an amphibious animal, whose constitution seems to have become acclimatised to all sorts and conditions of weather; but Rabbits cannot long stand wet food. Constant rain in August will rapidly kill them off with liver disease. Eating Farthing Weed, or Marsh Rot (*Hydrocotyle vulgaris*), which specially flourishes in wet summers, and is, therefore, then most temptingly displayed before them, is also said to be very deadly. Young Leverets are equally susceptible to the evil effects of wet food; a cold and damp November, with heavy and frequent white frosts, kills off the late litters. On the adjoining common of Honing, dead young Rabbits have been found beneath the nibbled leaves of deadly Nightshade (*A. belladonna*), although animals are generally supposed to devour this plant with impunity.

Reeds, and in fact, all marsh—and water—plants, flourish most in wet summers. Reed growing on a hard bottom and in deep water is the most valuable, because an inch of reed

below the surface is worth two growing above, since the submerged part is the hardest and so most lasting, and it is that end of the reed stem which is exposed to the weather when laid on as thatch. Neither plant nor animal life luxuriates in stale water, although I believe some rare crustaceæ are chiefly to be found in stagnant ditches. Neither Duck nor Snipe delight therein, and aquatic vegetation certainly flourishes most when frequent rainfall freshens up the water.

The most striking floral display on the common is that made by the Gorse : glorious acres of gold backed by the dark but glaucous green spiny foliage, which tones down the somewhat glaring yellow of the thickly clustering blossoms.

The best time and way to get the full benefit of the prospect and perfume of the April furze is to climb up into a neighbouring tree or look down upon it from an upstair window, when the sun breaks out afresh after a passing shower, and the humid atmosphere is full of the hum of Bees, the mellifluous song of the Blackbird, the clear, soft call of the careless Cuckoo, and the deceptive lambing of the courting Snipe as he throws himself violently down against the wind over his "clicketing" mate below.

Last autumn we had several consecutive nights with very heavy dews, followed by slight, white frosts ; the furze bushes were then thickly covered with Spiders' webs, which, dew bespangled and frosted, were a lovely and curious sight, looking for all the world like miniature fairy cradles suspended from all the outside sprays of the bushes. Gossamer Spiders' webs are also very numerous hereabouts in autumn, and I have seen the prismatic colours of the early morning sunbeams reflected so clearly from them, covering the surface of a newly ploughed field, as if it were a rainbow accompanying one on the other side of the fence whilst driving along the road.

The earlier deeper-hued Kingcups, or Marsh Marigolds,

almost as persistent in blooming as is the furze, and the later dainty Bogbean, each in their season have a peculiar charm of their own. Few British wild flowers increase so much in beauty and interest upon close and individual inspection as do the blooms of the last named, whose boiled down seeds were formerly looked upon as a specific cure for rheumatism —a reputation which they shared with Eel skins and Viper oil.

The Yellow Iris sheds a sheet of yellow over the Smeath, or South Fen, in early summer, but when one comes to examine the separate flower stalks, their beauty is spoilt by their untidiness: each single blossom lasting for a couple of days or so at the most; there are, therefore, almost always faded blooms whose incurved, dried-up petals detract from the brightness of the succeeding blossoms and pointed, uncurling buds. For several successive seasons, perhaps, it may be impossible to form any fair estimate of what a brave show the Yellow Gladden can, upon occasion, make, for two things are necessary for this semi-aquatic plant to display itself to perfection, namely, plenty of moisture—that is, rain —during the time that the rhizomes are growing, and plenty of warmth—that is, a hot and dry autumn to subsequently ripen them.

In 1907 the foliage of the Yellow Iris was hereabouts much damaged—literally eaten into ribbons—by multitudes of the caterpillars of a species of Sawfly; but failing to hatch any out from their pupæ, I was unable to have them identified. The Cuckoo flower (*Cardamine pratensis*) is either more plentiful or blossoms more profusely some seasons than in others. I have found a double form on the common, and Mr. R. Gurney showed me specimens of this plant which were propagating themselves by leaf-plantlets.

The white-tasseled Cotton Grass, and the comparatively inconspicuous Marsh Cinquefoil, the former bespecking and the latter closely carpeting some of the moister portions of

the common, and the lowly but dainty petalled Bog Pimpernel, are here in plenty, though the erect, pallid, pink blossoms—large in proportion to the foliage of this small marsh creeper—may easily be overlooked.

The road-side and hedgebank attractions in their seasons are : small yellow Stone Crop, Live Long (*Sedum telepixum*), Vervein, Woodsage and Harebell, small Scabious, St. John's Worts, Yellow Rattle and Eyebright, Polypody of lengthy fronds, and *Blechnum boreale*. Adder's Tongue, Marsh Fern, Glaucous Stitchwort, and Grass of Parnassus may be found, whilst *Adiantum nigrum* and Alexanders proclaim proximity to the sea. *Ruta muraria* grows on the church walls.

I have found all three shades of the Milk-wort, pink, white and blue ; the rarer Bladder-wort (*Utricularia minor*) has occurred, and Liparis also. One plant of *Spiranthes autumnale* was discovered on the holmes last year. Meadow Sweet, Purple Loose-strife, Figwort and Hoary Willow Herb of giant proportions clothe the banks of the Hundred stream in which the yellow Water Lily grows.

There is but little Sphagnum or Drosera. The Furze Dodder clings to some Gorse bushes near the school. I have had a Morel brought me from Ruston, enormous Puff-balls (or Bulfer as we call them)—useful for staunching blood or quieting Bees—grow amongst the Furze, where pale lemon stagshorn-like Clavaria occurs in autumn, and, in winter, grey, beard-like Lichen depends conspicuously from the whitethorn stubs on the shady side of the fences.

I.

A TRIP TO SPAIN, APRIL, 1908.

By Miss M. L. Buxton.

Read 26th May, 1908.

I HAVE been asked to read a paper to-night on a tour I have just been making in Spain. I had been there about three years ago, and have felt irresistibly drawn ever since to return there. So, this year, finding a cousin of mine equally anxious to visit that country, we made a plan to go in April. We sailed on the 3rd, seeing very little on the way out until we rounded Cape St. Vincent, when we came across numbers of Lesser Black Backed Gulls and Gannets, in both mature and immature plumage.

I had been given an introduction to some English people in Jerez—which is the place near Cadiz, where all the sherry is made. These people own a large shooting estate on the further banks of the Guadalquivir, and I was told that they would probably be able to show us some Bustards in the cornland round Jerez, even if we saw nothing else.

We landed at Gibraltar on April 8th, and the next day started off by rail to Jerez, at 6.30 a.m. Though it is a distance of only some 160 miles, it took us over twelve hours to accomplish. Spanish trains, like Spanish people, move slowly, and think to-morrow will do just as well as to-day.

The first few hours the line is one of the most beautiful I have ever seen, running through the cork forest, and from thence rising through broken rocky ground up to Ronda, a beautiful old Moorish town, situated on the edge of a deep chasm. The flowers all the way are wonderful; mostly Cistus of different sorts—pink, yellow and white—the most showy being a large white one, growing eight or ten feet high.

There were also double pink pæonies, yellow and blue lupins, a small blue iris, and countless other small and brilliantly coloured flowers. We did not see a great many birds, except Hoopoes and Woodchat Shrikes, of which there were quantities.

As we neared Jerez we came into the level country bordering the marshes—it was again one sheet of flowers of every colour and description, broken by Palmetto scrub. It is all over these plains that the finest bulls are reared for the bull fighting, and we passed great herds of these black bulls looking very picturesque on the plain. We began to look out for Bustards and for the first time saw Storks standing about near the muddy ponds, and Marsh and Montagu's Harriers hovering and beating about, low over the ground. At last we came to the cornland round Jerez, and there, just as the sun was setting, we saw one splendid old Bustard standing in the corn, fairly near the line. We were not much impressed by Jerez itself, and were extremely pleased, when shortly after our arrival, my friends walked into our hotel and introduced themselves.

The next day we spent with them, and my host presently remarked that if we were really in earnest about the birds, he would send us out to his shooting estate for a night, where we might see a Flamingo and a few other things. Our joy knew no bounds then. We had hardly expected to see even a Bustard, but to be told we were to go out to this wonderful bit of country seemed almost too good to be true. Accordingly we changed all our plans, went straight off to Seville and Cordova where we had some very enjoyable days, and returned to Jerez on the following Wednesday, the 15th. However, things were not to go favourably with us at once. and not till the 19th did we finally start. All the week there had been a strong south-west wind making it impossible for us to cross the mouth of the Guadalquivir.

At last, early on the morning of the 19th, my hostess came to me and said we could go. We were not long getting ready then, and accompanied by our host and hostess, we caught a 9 o'clock train—it actually took us two hours to go a distance of nineteen miles—to a place called San Lucar, from where,

a short drive took us to the little town of Bonanza, on the banks of the Guadalquivir. From this spot, the same from which Christopher Columbus sailed on his famous expedition, we were at length able to cross the river.

To any one who has read Abel Chapman's "Wild Spain," anything I am now going to read will already be familiar. The "Coto" as it is called, or estate, is roughly divided up into pine forests and sandhills, and then flat plains and marshes. It is a sort of triangle between Cadiz Bay, the river Guadalquivir and the Marismas, which are huge tracts of level plain running up the valley of the Guadalquivir, about two feet under water six months of the year and hard baked mud the rest.

Two keepers met us at the landing stage and we walked up to the lodge, through the warm scented pine forest, carpeted as usual with every kind of flower. The lodge was a great big place and most comfortable. The King of Spain had been there only about a week before us, so we lacked for nothing in the way of comforts. We then began to discuss our plans and found from the keepers it would be quite impossible to see much from this lodge, we must go to the other one, fifteen miles off. My host was a true sportsman and seeing how keen we were, immediately arranged everything for us. Soon after, he and his wife took their departure, leaving my cousin and myself with two keepers and a man-servant, and nothing to do but enjoy ourselves. The next day, Easter Monday, we were all in the saddle by 8 o'clock, our manservant balanced on the top of an enormous pile of our provisions, bedding and luggage, beneath which nothing of his horse was visible but just its head and legs.

First we rode through pine forest, seeing a great many warblers of different kinds in the open glades, the only ones I could identify being Black-headed, Dartford, and Rufous, the latter of which is especially conspicuous both in colour and habits. We also saw Woodchat Shrikes, which seemed to sit on every bush, and a good many Hoopoes. It was now also that I had a really good view of Bee-eaters for the first time since we landed. As they were all flying very high,

and appeared to be going in a northerly direction, I suppose they were still migrating. After a little while we came to the sandhills, a truly wonderful sight, some of them fifty or sixty feet high. They are always being blown by the wind, and gradually the pine trees become enveloped in sand, till some only show their tops sticking out, and others have completely disappeared, while again, as though to show its work, the sand has drifted on, uncovering the dead stumps of the trees that a short while ago were green and healthy; a most weird and desolate-looking spectacle it is. Yet there is plenty of life even here. There are tracks of animals everywhere—chiefly Lynx, Fox, Wild Cat and Red Deer. We saw a good many Eagles and Kites too, but it was quite impossible to identify them, and the keepers were not very certain about them. One Eagle's nest we found at the top of a small group of silver poplars, but there were no eggs in it, and the old birds were soaring miles away almost out of view.

Fortunately for us it was a cold season for that country, and although the sun was hot there was always a cool breeze. Beyond the sandhills there was more pine forest, and then we saw the open plain stretching before us as far as the eye could see, and still some way off was our other lodge, the "Palacio" as it is called. We rode into it about 12 o'clock, and found it even bigger than the first one and a most picturesque old building. The inhabitants, which consisted of the wives and families of some of the keepers, were not expecting us and were simply delighted at our arrival. As we were the first ladies who had ever been there, except a very few during the shooting season, they did not get over their excitement for some time.

The "Palacio" stands on the edge of the Marismas, and in front of it, stretching away to the sea is a plain thickly covered with different kinds of cistus and tree heather, with many other sweet smelling things, such as rosemary and lavender—all of which scent the air in the most delicious manner. Across this we rode in the afternoon, to some lagoons not far off. We saw the usual Montagu and Marsh Harriers and Black Kites, and I saw an Azure Winged Magpie and a great Spotted

Cuckoo. After seeing a good many Buff-backed and Purple Herons and Little Egrets, we came to the lagoons, round one of which a quantity of these birds were sitting in the tree heather which grows some six or eight feet high there. We rode in among them finding hundreds and hundreds of them with Night Herons and Spoonbills, and then we suddenly realized that they were breeding and that we were right in among their nests which are of the most sketchy description. They were built two to five feet from the water, among the heather which is very straggly, and hardly appears strong enough to bear the weight of a Thrush's nest, far less a large colony of Herons. It was one of the most wonderful sights, all these thousands of great white birds, that made a noise like the wind as they rose, whitening the sky. One could touch them with a stick and it was too absurd to see them trying to settle on the extreme tips of the heather with their long, awkward legs. The Purple Herons were mostly breeding in the next lagoon, and the two nests I looked into had five and six eggs respectively, though Col. Irby in his 'Ornithology of the Straits of Gibraltar,' says, "As a rule they lay three eggs, rarely four," and Mr. Howard Saunders also gives three as the number. On our way home we rode by other lagoons and low sandhills, seeing a great number of Ducks—chiefly Pochards, Ferruginous and Tufted. There was one pair of Widgeon, though these birds do not often stay after March. Also Great Crested and Eared Grebes, and by the edge of the lagoon we found Kentish Plovers and Dunlins, the latter very handsome in their summer plumage.

We were watching a Norfolk Plover when suddenly our dogs, of which we had seven or eight, began barking loudly, and out of the bush ran a splendid old Wild Boar. As may be imagined we were very soon in hot pursuit, and, we had some good views of him till he finally took us to the forest, and there we left him. He was the only one we saw, and I think we were lucky to see him so well. That evening we sat outside listening to the Norfolk Plovers and Little Owls which seem to swarm in those parts.

As our chief object was to see Flamingos and Wild

Camels, and as a pair of the latter had by great good luck been seen within reach of the "Palacio;" the next day, Tuesday, we decided to try and find them. I do not suppose many people have heard of wild Camels in Europe, in fact, there are few in Spain itself who know about them. About the beginning of last century a Spaniard imported some—I think about 200—hoping to be able to work them, but owing to the horses' dislike of them and various other reasons he had to give them up, and turned them out somewhere near Cadiz. They wandered away to this lonely tract of land, where they became entirely wild. Occasionally one gets shot by a shepherd or charcoal burner, but they are rarely seen at all. They live right away in the wildest parts of the Marismas, the extraordinary thing being that half the year they spend a great deal of their time wandering about up to their knees in water. They breed every year, but there are only about eighty of them left now.

As I have said the Marismas are still under water at this time of year, so the keepers took us in punts, one of them on his Horse pulling us. We went thus for some two hours, but could nowhere see any signs of the Camels, only great herds of Horses and Bulls standing about in the water, and living on a very scanty and coarse kind of rush; though how they live at all is a complete mystery. We had a wonderful sight of birds as we moved slowly along. There were Black-winged Stilts everywhere, looking very odd with their long legs when they flew, and nearly as numerous were the Pratincoles looking like enormous Swallows. There were, too, a good many Redshanks and Green Plovers. On one of the small, muddy islands of which there are a good many in parts, we found Avocets just beginning to lay, and almost the prettiest of all were the Whiskered and Black Terns. They, with the Gull-billed Terns were in large numbers everywhere. Presently the keeper who was riding stopped and pointed, and away in the distance was a long line of great pink-looking birds. They were Flamingos. They settled after a bit, and we managed to get fairly close to them. Most of them were feeding with their heads right under water, only they walked

so fast as they fed, they soon walked right away from us. We then gave up the Camels for that day and returned home, seeing vast numbers of Ducks—mostly Pintail, Marbled Duck, and Mallard. Frequently we saw what looked like a small cloud on the horizon, which on closer inspection we found to be great numbers of birds, I think probably Ducks, but at that distance it was impossible to tell, anyway, there must have been thousands and thousands of them.

The following day, the 22nd, on talking it over, the keepers thought we might see the Camels by riding across the Marismas, so at 10 o'clock we started off. We found a Stork's nest at the top of one of the Cork Oaks which grow along the edge of the Marismas, and the lower branches of the tree were simply infested with Jackdaws, which live in colonies in the rotten boughs. We saw several Magpies' nests also, built about a foot from the ground in the yellow Cistus bushes. After a little while we struck off across the Marismas, and for three hours kept up the same steady if somewhat slow pace. Then we came to a long strip of baked mud and a kind of bush Samphire growing on it, and looking through our glasses at every speck on the horizon, we saw to our joy two animals, that certainly were neither horses nor cattle. Riding on a little way they became quite unmistakable, two old Camels feeding among a lot of cattle. We rode on rather sideways to them, gradually getting nearer, and after having had a good look at them within about 500 yards, we rode straight at them, getting within a good 150 yards before they slowly began to move away. As soon as we stopped, however, they stopped, and so we had a very fine view of them, and indeed were most fortunate in doing so; had we got off, no doubt they would have gone off long before. On our return we rode up to a flock of Flamingos. There must have been several hundred of them, most of them asleep. They are a lovely pink when their wings are closed, but when they fly the almost crimson red of their wings is quite beautiful. They made a noise like a lot of old geese as we put them up.

That evening as I was wading through one of the lagoons to look at a Coot's nest, I felt something struggle under my

foot, and looking down found a large, very well marked Water Tortoise. After that I found several others and Land Tortoises too. The country abounds in Snakes and Lizards of every description, I believe, but oddly enough we saw very few ourselves. One day I saw a large Ocillated Lizard nearly two feet long, most beautiful, but I believe dreadfully destructive to young birds and eggs. Of the numerous Eagles and Hawks we saw, it was only possible to identify very few. Each day, too, I wished I knew more about the flowers and butterflies ; but there is the work of years anywhere in the South of Spain in every branch of Natural History, for any one who cared to go. For there is combined the almost tropical fauna with that of more Northern Europe. It seems the meeting place of North and South. I only saw the very outside surface of things so to speak. For first I had no time, and secondly I know very little about such things except that which is obvious to any one. Yet in that one week I saw more wild life than one might see in years at home.

Our last day at the " Palacio " came all too soon, and we started off very early riding over to the sea. The sea is only about three miles riding straight from the Palacio—a thin belt of pine forest running along inside the sandhills that shut the sea out. In these hills we saw a good many tracks of Lynx and Wild Cat, but never got a glimpse of the animals themselves. We found several different kinds of flowers on the sandhills—Thistles of various sorts, and a good many bulbs that were not yet in flower. On the shore we saw a lot of Curlew and some Lesser Black-backed Gulls, and other Gulls I could not make out, also some Little Ringed Plovers. We rode about six miles northward along the shore—passing some tiny fishing settlements—mostly Portuguese—and to judge by the excitement we caused, I should think they had never seen any human beings but their own families before ! We rode on to the end of our beat, and then turned inland over the sandhills, getting off in the middle of the day for an hour to eat our lunch and rest our horses. The sun was beginning to get fairly hot, but the cool breeze still refreshed us. It would

have been perfection lying under the sandhills in a bed of rosemary and lavender, with not a sound to break the silence but the Bee-eaters and Swallows, had not the place been infested with enormous Black Ants which always appear in thousands the moment one sits down anywhere, so that it is impossible to enjoy a moment's peace. On our way home, we again visited the Herons' lagoon, and came on a flock of Glossy Ibis feeding along the edge, and looking like a lot of big black Curlews. There were also several common Sandpipers about.

Then our last day, Friday, came, and we were again making our way back to the other lodge, the "Marismillas." My cousin had a wonderful gift of making herself understood, though we could not speak Spanish and the keepers could not speak English; so by this time we could all understand each other perfectly, and kept up a ceaseless flow of talk and gesticulation. We saw a great many Golden Orioles, the first we had seen, and we succeeded at last in finding a Norfolk Plover's nest—or rather—its two eggs, which were simply layed on the flat open sand with no pretensions at concealment whatever, although there was plenty of growth about, and a good many stones in places. The keepers never could understand why we took so much trouble to find a nest and then did not want the eggs. I am sorry to say on our return to the "Marismillas" the children had collected me several eggs—amongst others the lovely pink coloured ones of the Icterine Warbler. All the blackbird's eggs I saw, seemed to me rather smaller and were much brighter blue than ours: as remarked by Abel Chapman. We stayed at the "Marismillas" on Friday night, and then with great sorrow said farewell to one of the most fascinating and beautiful countries one could well see. As to the few people that live there, consisting of the keepers' families and some charcoal burners, they are a type which I fear will gradually disappear with the growth of foreigners in the country. Perfectly simple and trustworthy, they are the most absolute gentlemen you could see anywhere and the most delightful companions. We arrived at Jerez that night and had to hurry off next morning to Ronda. On the way we several times saw Little Owls

sitting on the edge of the railway cutting, quite undisturbed by our train. We also saw Black-eared and Black Wheaters and at Ronda, White-bellied Swifts which seemed more numerous than the common ones.

Finally we reached Algeciras again on Monday 28th, only to find that our ship was late and would not be in till Thursday. The time, however, was not wasted. One day we spent going all over the Rock from the top of which is a most wonderful view—and the Rock itself is covered with all kinds of flowers, and a good many birds. We sat and watched one pair of Orphean Warblers for some time, but were unable to find their nest. Everywhere we saw Blue Rock Thrushes and numbers of Lesser Kestrels. At last our ship came in, and with many regrets we left one of the most delightful places in Europe.

The sea this time was like a pond all the way, but we had to spend two dreadful days in the Channel, mostly anchored off Beachy Head in a dense fog, always an unpleasant experience. However even now we weren't to be entirely deserted. At about 9 o'clock on the morning of May 4th, numbers of Warblers suddenly appeared out of the fog. Chiff Chaffs, Willow Wrens and White Throats lighted all over the decks, and on our heads and shoulders, they looked too, miserably wet and cold. They left us after about an hour, and then a lot of Yellow Wagtails appeared in very fine plumage, and they with a large number of Pipits and Larks, a pair of Pied Wagtails and a few Whinchats stayed the rest of the day. A splendid old Ringed Plover also sat the whole day in the same place, every now and then taking a little run and bobbing his head up and down as though he thought he had come to an odd place this time. A Turtle Dove and later a Kestrel flew once or twice round the ship, but did not settle, and Swallows and Martins were flying round us all the time. The Yellow Wagtails were the most delightful, running about all over our deck, under our chairs and between our feet—even eating the bread with which the passengers plentifully bestrewed the decks. The remarks of these passengers were worth hearing. One said he knew a great

deal about birds—the yellow ones were Linnets and the little dull coloured ones were Sparrows, they were the young birds that could not fly very well. And another person said on seeing one of the birds open its beak, "They must be tired," he had "just seen one of them yawn!"

When we woke next morning all the fog had gone, and our journey ended at last.

II.

A WEEK IN BRECKLAND.

By W. G. Clarke.

Read 29th September, 1908.

To judge of the fauna and flora of any district by an examination during any one week of the year is to gain but a fragmentary idea of its variety and extent, but viewed simply as a portion of a whole and as a seasonal record it may not be without interest. From August 28th to September 6th I spent most of the hours of daylight on the heathland in the vicinity of Thetford. Day after day a companion and I wandered about without seeing any individual whom it was possible to speak to; not once during the week did we meet anybody on the heaths, or public tracks across them. This may in part be accounted for by the unsettled weather, heavy rain and thunderstorms prevailing all the time, with a temperature much below the normal

Weather conditions were also partially responsible for the comparative absence of animal and bird life. With the exception of Rabbits and Hares, the only wild animals seen were Water Voles, a Squirrel, and a solitary Weasel. With birds there was little more diversity. In addition to the ordinary hedgerow species, a number of Stockdoves were disturbed from their homes in rabbit burrows; and Stone Curlews not infrequently flew out of patches of bracken, though their shrill call was much less rarely heard than is usual at this time of the year. The harsh note, or wavering flight of the Green Woodpecker were the most common sign of bird-life on the heaths or among the heathland plantations; small parties of Goldfinches and Yellow Wagtails were frequent on some heaths; and in the pine woods Long-tailed Titmice and Golden-crested Wrens frequently gave evidence of their presence. On September 6th there were signs of a migratory movement. Thousands of Lapwings were travelling in big flocks from east to west, and far more numerous companies of Starlings from north-west to south-east. Even the bird-life of the meres was of much less interest than usual. There was a fair number of Coots on all the heathland meres; a pair of Moorhens on the Punch Bowl; a few Gadwall on Ringmere, Langmere and Fowlmere, and fifteen Tufted Duck on Langmere.

With regard to Mollusca, a few minutes' search revealed *Planorbis alba* and *Limnæa stagnalis* in Ringmere and Langmere; and *Helicella virgata* and *Helix caperata* on Thetford and Santon Warrens. The only discovery of interest, was, however, that made by Mr. A. Mayfield, M.C.S., who accompanied me on two days. On a portion of Santon Warren in the parish of Thetford St. Peter, under big fragments of chalk excavated from the flint-pits near St. Helen's Well he found four specimens of the tiny *Jaminia muscorum* var. *bigranata*, and two approximating to the tridentate form. The only place in England in which the last-named variety had previously been found was on Lingheath, Brandon, where it was first discovered in July, 1904, by Dr. G. W. Chaster, and its occurrence in Norfolk, on the northern bank of the Little

Ouse and some three miles from Lingheath is therefore of particular interest.

Though the time we devoted to botanising was brief, in a district containing so many botanical rarities, and such a curious flora, it was impossible not to find plants that caused the hearts of more than one botanist to rejoice. Concerning the general aspects of the heathland flora it is, perhaps, worthy of note that the bracken averaged two feet less in height than in 1907, and that the heather was nowhere so brilliant as in the previous summer, though its beauty was not less when contrasted with the flaming yellow heathland bents. Another striking contrast was formed by the yellow sprays and scarlet berries of the dying White Bryony (*Bryonia dioica*) which had climbed over the fir hedges, and in some cases had mounted spruce fir trees and hawthorn bushes to a height of twenty feet. One of the most striking features of the heath and roadside vegetation of the district were the bright-coloured rosettes of leaves from which next year will ascend the stalks of the Hound's Tongue (*Cynoglossum officinale*), and the brown, shrivelled stalks, and hooked seeds of this year's plants. No one who has had occasion to walk where they abound will doubt for a moment why the people of the district term them "little burdocks." Another common and conspicuous plant was the Cotton Thistle (*Onopordum acanthium*), though perhaps more common and more conspicuous was the Black Moth Mullein (*Verbascum nigrum*). Ragwort (*Senecio Jacobæa*) is still very abundant, and this year seems not to have been affected so much as usual by the caterpillar of the Cinnabar Moth, but the most astonishing instance of rapid plant distribution in the district is that of the Canadian Fleabane (*Erigeron Canadensis*). It abounds everywhere, from the dwarfed specimens three or four inches in height on the heathland, to those 2 ft. to 2 ft. 6 in. on cultivated ground. Gardens and waste ground in the town of Thetford are afflicted by this plague: it grows by every roadside, on heaths and warrens, and on the borders of some of the cornfields is taller and more luxuriant than the crop itself.

The Blue Fleabane (*Erigeron acris*) we noted on Barnham Cross Common, near the Croxton road Railway bridge, Thetford, and on the Wretham heaths. The most widely-distributed heathland plant in blossom was the Eyebright (*Euphrasia officinalis*), while the white-flowered form of the Hemlock Stork's bill (*Erodium cicutarium*) appeared to be as abundant as the type.

On ancient heathland north of Weeting Mr. W. A. Dutt and I found dwarfed forms of a number of plants including a small pale-flowered form of the Self-heal (*Prunella vulgaris*), the Field Gentian (*Gentiana campestris*), the Hoary Cinquefoil (*Potentilla argentea*), common Centaury (*Erythræa centaureum*), Lady's Fingers (*Anthyllis vulneraria*), Dwarf Thistle (*Carduus acaulis*) and Knotted Spurrey (*Sagina nodosa*) which also occurs in abundance near Ringmere, Langmere and Fowlmere, on Thetford Abbey Heath and Two-mile-bottom Common. Specimens of Gentian (probably *campestris*) were so arrested in growth by the attacks of a fungus that it was impossible to give them specific identity. I sent an example to Dr. C. B. Plowright, F.L.S., and he identified the fungus as *Puccinia gentianæ*, Strauss, comparatively a recent addition to our flora, and not previously recorded for Norfolk. On sandy fields, bordering these heaths and near Mount Ephraim, Weeting, were numerous examples of the Red Hemp-nettle (*Galeopsis Ladanum* var. *angustifolia*)—confirmed by Mr. Arthur Bennett, F.L.S., and only previously recorded for Norfolk by Rev. E. F. Linton, who found it at Loddon in 1900—the Common Hemp-nettle (*Galeopsis Tetrahit*), the Field Melilot (*Melilotus arvensis*), the Blue Pimpernel (*Anagallis cærulea*), the Little Toadflax (*Linaria minor*), Field Madder (*Sherardia arvensis*) and Basil Thyme (*Calamintha Clinopodium*) a white variety of which was common both here and on Barnham Cross Common. Everywhere, too, there was evidence of the abundance of the Purging Flax (*Linum catharticum*) a month or two previously.

On other days the Carline Thistle (*Carlina vulgaris*) was noted on the slopes of a road embankment on Thetford Warren; Good King Henry (*Chenopodium Bonus Henricus*) on the

Drove road near the Punch Bowl and in the middle of West Tofts Belt; and the Henbane (*Hyoscyamus niger*) with its curiously arranged double row of capsules, among the mounds which mark the site of St. Helen's Church, Santon, and almost surrounded by a luxuriant growth of Sand-sedge (*Carex arenaria*). The Rock-rose (*Helianthemum vulgare*) was found abundantly on the south and west sides of Grimes' Graves plantation, growing on the outskirts of the wood in tufts two or three feet long, kept short by the Rabbits like many of the heather-tufts, no spray being more than three inches in length. In the track made by the horses on the "Drove," immediately west of West Tofts Belt, in a site first noted by Mr. H. Dixon Hewitt last year, Mr. Mayfield and I found the rare Moss-like Tillæa (*Tillæa muscosa*) not uncommon, appearing at first sight like a dwarfed form of *Sedum acre*. On the "Drove" also, near the Punch Bowl, we noted the Spathulate-leaved Cudweed (*Filago spathulata*) and on the shores of Langmere, the Golden Dock (*Rumex maritimus*) an inland station for this seaside species, which here only attains a height of from two to three inches. Large patches of Ringmere, and a belt extending from end to end of the long pool in Langmere were occupied by Amphibious Persicaria (*Polygonum amphibium*) which in full bloom presented a spectacle of wondrous beauty. On Thetford Abbey Heath there was an abundance of the Thyme-leaved Sandwort (*Arenaria serpyllifolia*) while a small patch of marshy ground on Thetford Two-mile-bottom Common contained Toadrush (*Juncus bufonius*) Bitter Cress (*Cardamine amara*). Thyme-leaved Speedwell (*Veronica serpyllifolia*) and a colony of Buckbean (*Menyanthes trifoliata*), the nearest known station of which is at Wilton, seven miles distant.

Many of our best finds were, however, made on Barnham Cross Common, where Mr. Dutt and I followed in the footsteps of Mr. Dixon Hewitt. Here we found fairly commonly the Field Southernwood (*Artemisia campestris*); the Spanish Catchfly (*Silene otites*), the Thorny Rest-harrow (*Ononis spinosa*), the Perennial Knawel (*Scleranthus perennis*), and the Purple Mountain Milk-vetch (*Astragalus danicus*), and the White

Horehound (*Marrubium vulgare*) on the slope of Weaver's Close. Two of the commonest plants were the pretty Hare's-foot Trefoil (*Trifolium arvense*) and the Sheep's Scabious (*Jasione montana*).

Most of the week was, however, spent in the study of prehistoric archæology—ancient trackways, barrows, flint-quarries, earthworks and settlements. Only with a portion of the results can I now deal. Some of the ancient pottery found was of more interest than usual. One piece from a settlement on Thetford Warren was grey where it had been broken, with a thin coating of pink inside and a thin green glaze on the outside, which was ornamented with a double row of depressions made by pressing some pointed instrument —perhaps a bone—into the wet clay. A large quantity of broken pottery was found lying on the surface of Santon "Breck" at the eastern foot of Bromehill, newly-ploughed last winter after lying fallow for many years. The pottery was of different periods, some very rough and coarse with small pebbles therein probably dating from the Neolithic or Bronze Ages. One piece of grey ware has ornamentation made by impressing the thumb on a raised band, while another piece of the same colour has three incised lines one below the other. Most interesting, perhaps, is part of the base and side of an urn, in the interior of which some scores of tiny pebbles had been impressed when the clay was wet, probably with the idea of strengthening it in order to withstand the strain caused by dropping red-hot "pot-boilers" into the water contained therein. Interesting also were the many fragments of undoubted Roman pottery, much of the grey being like that commonly found at Caistor Camp and Burgh Castle. There are also a few pieces of Castor ware, with cream interior, and chocolate exterior, ornamented with raised floral patterns in cream.

Santon "Breck" also yielded a number of good flint implements, including awls, axes, borers, discoidal implements, fabricators, gravers, hammerstones, hollow scrapers, knives, scrapers and triangular knives. Two of the triangular knives were typical specimens, one having one surface chipped all

over, and another having two edges chipped on each side and the other edge curved and unchipped. A third triangular knife is of different form to any I have seen. Many of the implements from this "breck" have the curious striæ (first noted, I believe, by Dr. W. Allen Sturge), a due consideration of which may very conceivably enlarge all our conceptions of the antiquity of man. Mr. H. H. Halls also found a noteworthy implement—an oval knife 2½ in. by 2 in. of thin horn-coloured flint, having on one side a good bulb of percussion with the top off, but no secondary chipping, and a narrow rubbed edge, while on the other side the chipping is almost rippled, with fine work on the edges, and a narrow rubbed band at the edge.

During the week I found near Grimes' Graves a pointed scraper of a type chiefly associated in Norfolk with Brom Heath, and a knife with a polished cutting edge; on Thetford Warren half a hammerstone, the patina showing that it must have been split by a severe blow in the Neolithic Age, a rectangular implement the top of which is partly occupied by the cast of a fossil Echinoderm (*Discoidea cylindrica*), an oval implement, the flat underneath part of which is formed of fossil sponge (*ventriculites*), a button-scraper practically devoid of patination, and a fine harpoon-barb of the type described in last year's 'Transactions.' My most interesting finds from other localities were a borer from Santon Warren, and a single-edged saw, with 32 most delicately-chipped teeth on a length of 1½ in., from the table-land on the north bank of Langmere, where the implements and pottery I have previously found, betoken that there was once a Neolithic settlement.

III.

WITH THE BRITISH ASSOCIATION AT DUBLIN.

By F. Long, L.R.C.P.

Read 27th October, 1908.

I attended the meeting of the British Association at Dublin in September as delegate from this Society. There were two meetings of the Conference of Delegates, at both of which I was present. On September 3rd, the President, Professor H. A. Miers, F.R.S., gave an address "On the Educational Opportunities of Local Scientific Societies," in the course of which he said, as scientific literature had become more highly organised, it had fallen more and more into the hands of specialists, and that, from the amateur's point of view, was to be regretted, for he could no longer get an adequate insight into the modern advances of science without either going through a special course of reading for which he had no time or attempting to master a treatise which he could hardly understand without some preliminary training. If it was difficult for the amateur to extract information from the text book or treatise how much more difficult was it for him to learn anything from the proceedings and meetings of these societies. If the language of text books was so technical that it was hard to understand, how much more unintelligible was the specialist jargon of a society, in which it often happened that a paper, though read in a meeting of specialists could only be followed by two or three of those present. He was not protesting against scientific language in itself, but he did feel that it was discouraging to the earnest student to find himself confronted by books he could not understand, or

condemned to attend meetings where the language spoken was a strange and uncouth tongue.

Could not the local societies in addition to their ordinary work, make a special effort to satisfy the needs of the many intelligent people who had not access to laboratories, museums and scientific libraries, but who desired to know more of science. He considered that very much of the estrangement between different sciences or even between the branches of the same science was due to the exaggerated use of technical language, where it was not necessary. The most useful function in his opinion that could be performed by local societies, was to encourage the habit of expressing scientific results in simple and intelligible language that would appeal to the whole society. There were very few scientific ideas or facts that could not be expressed in homely language freed from technical terms, and though it was necessary for purposes of brevity and precision to make use of technical terms in the journals of the more specialised societies, it ought to be wholly unnecessary to do so in societies which embraced a number of interests and whose members were to a great extent persons without scientific training. Nothing could be better or more useful for the specialist himself than to try and explain his work in simple language to a mixed audience: and if the local societies could encourage the specialist to come to them and describe his own researches in simple language, they would do him as much good as they did themselves.

Let the professional scientist become less professional and let the amateur become less amateurish when they came together at the meetings of such societies. He believed that many a scientific investigator could enlist an army of willing workers through the local societies if he were given the opportunity of interesting them in his own work, suggesting to them lines on which to work and helping them on by advice and criticism. Something of the sort was occasionally done in the study of local flora and fauna—that it was not done more widely, was due to the prevalent and growing idea that none could take up original work without the preliminary of scientific training. Anything that tended to break down the

barrier between the professional scientist and the amateur was for the good of scientific progress. That the one should be ever discouraged by the other seemed almost incredible, and yet one had to confess that this happened again and again.

The second meeting took place on September 8th, Professor Grenville Cole presiding.

Professor G. B. Carpenter read a paper on "The Survey of restricted areas with regard to the Fauna and Flora." He desired to give a short account of what they had done and what they proposed doing in Ireland. He wished to impress upon local societies the important results that might be obtained by the systematic survey of local areas. He mentioned especially the survey of Lambay Island which had been carefully carried out within the last few years. The results were surprisingly good. They found five animals new to science, twelve new to the Britannic fauna and eighty animals and plants new to the Irish fauna and flora. One of the principal objects of the survey was to trace the migration of animals and plants on the east coast of Ireland. He also referred to the survey that was being conducted by the Dublin Naturalists' Field Club of the North Bull. The interest of that research was due to the fact that the sand bank was only a century old and the object of the survey was to ascertain what species occupied new portions of land. He mentioned that Clare Island was about to be surveyed, and he trusted that his remarks would have the effect of inducing local societies to have such surveys in Great Britain made as complete as possible.

During the discussion I took the opportunity of mentioning Mr. Robert Gurney's Laboratory on Sutton Broad, where a good deal of research work had been carried on by Mr. Gurney himself and by Mr. F. Balfour Browne who has unfortunately left Norfolk, but the mention of whose name was received with much satisfaction by Prof. Carpenter. I also said that there were charts and maps of the Broad district, and that any one wishing to make use of the laboratory could have board and lodging at moderate terms.

The chief topic of discussion was the means to be adopted for preserving our fauna and flora from extinction. Unfortunately there was a commercial value in plants which rendered them constantly liable to be taken both for public and private wants. A resolution was adopted. "Urging upon local societies the necessity of preserving the fauna and flora of their respective districts as against wanton destruction or careless or needless collecting."

IV.

EAST ANGLIAN PLANTS.

By Mr. A. Bennett, F.L.S.

Read 27th October, 1908.

The four species I now remark on will make some twenty species so treated, the whole mostly related to the East Anglian counties.

It has brought together such records and remarks as were accessible to me; but there must be much more matter to be searched out, and I trust that any member who may come across any reference to any of these species (other than recorded in these papers) will make a note of it.

Our plants are described over and over again, but nothing is added in the historical way. It has always been a matter of regret that Sir Joseph Hooker did not carry out his idea of an 'Historical Account of the British Flora,' mentioned in the 1st ed. of his 'Student's Flora.'

While of their 'Life Histories' we have very little account, yet the differences that can be seen between closely allied species when cultivated are most remarkable. Some can be identified on the appearance of the second leaf in seedlings.

Others show such remarkable modes of growth and constitution (if such a term is allowable), that they can be identified by the first radical leaves that appear. For instance, in such a critical genus as *Œnanthe*, the radical leaves of *Œ. silaifolia*, Bierb, always appear at the end of autumn, while those of *Œ. pimpinelloides*, L., do not until the spring. The former break through the ground with upright growth, the latter in a gyrate manner, *i.e.*, like a fern with its unopened frond laid sideways on the ground. The former cannot stand the wind if not protected by grass around it, the latter will do so. The former grows in grass meadows, the latter on dry hard ground.

You cannot get some species, such as *Hierochloe borealis* (the Holy-grass), or *Calamagrostis strigosa* (the Stiff-haired Reed) to flower, unless you confine the roots by planting them in a flower pot. And *Equisetum littorale* will burrow under a gravel path five feet wide, and reappear on the other side.

Although hundreds of British plants have been grown in Botanical Gardens for many years, yet beyond a record of their flowering, there seems nothing else noticed in Reports of the Gardens.

The proposal in the last issued part of the 'Transactions,' as to a Survey of the Broads is an excellent one. As yet we have no records of the Aquatics, such as are produced in America, or M. Magnin's "Recherches sur la Végétation des Lacs du Jura" * where he discusses the altitude, temperature, chemical constitution, congelation, statistics of the Flora, biological conditions, depth, &c."

I had the pleasure of seeing all the critical plants he gathered, of which several were new records for the French Flora.

FOUR EAST ANGLIAN SPECIES OF PLANTS.

I have here brought together the names, habitats, &c., of *Rœmeria violacea*, *Dianthus prolifer*, *Verbascum pulverulentum* and *Aira canescens*, as a further contribution to the botany of East Anglia.

* Revue Generale de Botanique v. 1893.

Rœmeria violacea. Medicus in Usteri Ann. Bot. iii. (1792) 15.

R. hybrida, De Candolle, Syst. 2, p. 92.

Glaucium violaceum, Juss. Gen. 236.

Violet Horn-poppy.

First record. *Papaver corniculatum violaceum.* In the cornfields beyond Swaffham as you go to Burwell (Cambs.). Ray. Cat. Pl. Cant. III., 1660.

Cambridge Co. 29.

Swaffham. June, 1823. July, 1835. Winch herb! "Petals fall by 10 o'clock." Winch, *l.c.*

Between Swaffham Prior and Burwell.

Babington, Fl. Camb. (1860). 13.

Newmarket. May 19, 1794. Rev. J. Hemsted.

Newmarket in a field behind Mr. Vernon's* house, probably not wild. Relhan. Fl. Cant. ed. 3. (1820). 212.

Reche. May, 1820. Swaffham Prior, 1820.

Prof. Henslow in York herbarium! 1835. Dr. Jermyn. Bab. Jour. of Life (1897). 38.

"In other parts of that county (Cambs.). Rev. W. Hemsted. Smith. Eng. Fl. 3 (1829). 8. No one else seems to have discovered where the other parts are. Has not been seen for many years. W. West in J. of Botany (1801). 249.

Norfolk E. Co. 27.

About 4 miles from Aylsham towards Cromer. Mr. H. Rose.

Once observed. Smith. Eng. Bot. 201. Sept.. 1794.

Fritton, 2 miles from Long Stratton. Winter in Phyt. (1861). 255. 291.

Norfolk W. Co. 28.

Swaffham. Hooker sp. to H. C. Watson. New Bot. Guide (1835). 126.

Swaffham. Dr. Jermyn ex herb. Newbould in Herb. Brit. Mus.

Fields not far from Castle Acre Priory. 4 miles from Swaffham. Cressingham 3 miles from Watton, and sparingly at Little Cressingham in flower before end of June. Winter in Phyt. *l.c.* But this author is rather discredited.

* W. Vernon, Fellow of Peterhouse, Cambridge.

Once seen in Surrey. Watson. Comp. Cybe. Brit. (1870), 479.

Distribution :—

Mediterranean region and Central Europe, Portugal, Spain, France, Greece, Turkey, Taurus.

DIANTHUS PROLIFER. Lin. Spec. Pl. (1753), 410.

First record.

"*Armeria polifera*, Ger. . . . . In the grounds 'twixt Hampton Court and Teddington." How. Phytol. Brit. (1650), 10.

Childing Pink. Proliferous Pink. Limewort.

WIGHT, ISLE OF. 10.

Ryde, Dover. Babington, 1835. Bell Salter in Herb. Brit. Museum. 1852 ! Now all built over.

HANTS S. 11.

Cumberland Fort. Portsea island. Herb. J. F. Young at Kew. c. 1837. 1890 !

In considerable plenty on the south beach of Hayling Island, along the way to the Passage House. Oct., 1848. Bromfield. Near Hillsea, Tatham, 1859. Near Southsea Station. 1870. J. Bot. (1871), 180.

SUSSEX W. 13.

In Selsea Island. Ray. At the beginning of the tongue of beach stretching from Selsey towards the mouth of Pagham Harbour.

Cooper in Botany of Sussex (1834), 27 ; Babington (Jour. of Life), 1849.

In several places about Pagham. June 25, 1901. E. S. Marshall sp.

KENT E. 15.

A mile and a half beyond Hythe, in a lane on the right of the road to Dimchurch. E. Foster in herb. Brit. Museum. Hythe Woods Herb. Borrer. Abundant on the Drilling ground, Hythe. F. J. Hanbury.

KENT W. 16.

Sandy bank, Malling, 1882. Crespigny in Rec. Club. Rep. 1881—2. 185.

23. Berks. Near Windsor. Lewis in herb Bot. Soc., London. Watson Cyb. Brit. (1847). 1. 190.

In a sandy field on the Boar's hill range in 1894, not seen since. Druce. Fl. Berks. (1897). 83.

Norfolk E. 27.

In a close on the bank side over against Hellesdon Old Hall, about a mile out of St. Augustine's Gate, Norwich. Mr. Humphrey in Bot. Guide (1805). 431. Mr. Pitchford in Herb. Smith. 1797.

Norfolk W. 28.

Fincham. Miss Bolton. Trimmer. Fl. Norf., 1866. 21. Sandy soil near an old barn in the bridle road leading from Stanhoe over Docking Common to Bircham Newton. Trimmer, *l.c.*

Reported in Cornwall, July, 1874. Temperé sp. Middlesex. Merrett. Worcester. Ballard.

Distribution :—

West Asia, Algeria, Canaries. All Europe except Norway, Sweden, Greece, and North Russia.

Verbascum pulverulentum. Villars. Fl. Dauph. II. (1786). 490.

V. floccosum. Waldst and Kitabel. Pl. rare. Hung. i. p. 81, t. 71. 1802.

Hoary Mullein.

First record. "*V. pulv. fl. luteo parvo.* J. B. . . . . *circa moena Norvici urbis.*" Ray. Cat. (1670). 312.

Suffolk E. Co. 25.

Dunwich. Davy: Back of Browston Hall nr. Yarmouth: Herringfleet Common: near Mutford Bridge. L. Wigg. Bury, Winch. Bury, near the Railway Station. A Bennett, 1899. In old chalk pits and roadsides about Bury, abundant beyond Northgate Street. Jordan, sp. 1876. By the roadside between Newmarket and Bury. Dr. Bromfield.

Fritton Wood. Paget; E. Oulton. Mc Aub. Near Lake Lothing. Hind. Flora (1889). 251. Gorleston. Phyt. (1863). 402.

Suffolk W. Co. 26.

Timworth; Fornham, Herb. Blake: Rushbrooke. Herb. Turner. Hind. Fl. *l.c.*

Norfolk E. Co. 27.

About Norwich everywhere, and in most parts of Norfolk. Sir J. C. Smith.

Near Acle and Hoveton Churches. D. Turner. Eaton, near Norwich, Forster herb! Norwich. 1799. Smith, herb! Heigham by Norwich, A. Bennett. Cawston, Woodrow. D. Stock; Earsham, Spalding; between Norwich and Swainsthorpe; Stoke Holy Cross. A. Bennett, 1876.

Sprowston and Rackheath. E. F. Linton; Crostwick, Hellesdon! Bradeston, Swannington, S. Walsham; Cossey; Banham; Ranworth; Cantley; Kirby Bedon, Metton. K. Trimmer, Fl. Norf. 100. 1861.

Thorpe, 1826. J. Priest! 1851. H. D. Geldart. Eaton, 1838. J. W. Ewing; fide Miss Geldart. About the ditch on the outside of the Castle Walls, Norwich; and between Bishopgate Bridge and the ferry house, both places plentifully. S. Alcorne in Blackstone's Spec. Bot. 1746.

Norfolk W.

Snettisham and Swaffham. B. Bray ex Nicholson. Stanhoe: Ringstead (1896). Ickburgh, Hillborough, Burnham Overy; Wells; Binham; Walsingham; K. Trimmer, Fl. Norf. *l.c.*

Burnham Westgate, Miss Bolton; Burnham Deepdale and Brancaster, Miss Bell; Newton Southacre, E. F. Linton; Hillington and Castle Acre, C. Forster, Jun. Thornham, Rev. W. E. Thompson, 1902. Heacham, Rev. W. Kirby, c. 1798, fide Miss Geldart.

Reported in Surrey (*V. Lychnites!*)

North Hants. No sp. extant.

Distribution :—

Spain, France, Belgium, Germany, Switzerland, Italy, Hungary, Dalmatia, Turkey, Holland, Istria, Montenegro, &c.

Eng. Botany, t. 487. Sept. 1, 1798. Sent from Norwich by Mr. J. Wagstaff, as the true Norfolk Mullein. Who was Wagstaff? there is no mention of him in the Biogr. Index of British and Irish Botanists. 1893—99.

Aira canescens, Lin. Sp. Plan. (1753), 65.

Weingærtinera canescens, Bernhardi, Fl. Erfurt (1799), 51.

CORYNEPHORUS CANESCENS, Beauv. Agrost. (1812). 90.
Grey hair-grass.

First record. "*Hoc gramen radice capillata crassine maritimus litores Kantiæ ornitur.*" Lobel. Illut. 8. 1655.

But the plant is not known in Kent, and I have carefully searched the reported habitat, and find an Agrostis that strongly simulates the Aira. The first record with a definite locality seems to be "on the coast of Norfolk and Suffolk." Smith. Fl. Brit. (i. 1800). 87.

But Petiver in Concord. Gram. No. 126, 1716, says, "Lobel first discovered this on the coast of Kent, and Mr. Buddle since him in Suffolk."

SUFFOLK E. Co. 25.

Lowestoft Denes. A. Bennett. Benacre. Herb. Skepper. Near Euston Broad, and between Covehithe and Pakefield, Holmes.

Homersfield Heath on Post-glacial gravel with Teesdalia, &c. W. Cordvall. Fl. Harleston, 31, 118. 1888.

SUFFOLK W. Co. 26.

Roadside between Lakenheath and Wangford. Culford Heath. Druce sp. Rec. Club Rep., 1883. 25 (1884). Lackford Heath. W. G. Clarke.

NORFOLK E. Co. 27.

Most abundant on Yarmouth North Denes to Caister. L. Wigg. I saw it there in 1877—1883. 1889.

Sandhills at Caister and Hemsby. D. Turner. Scratchby Sand-cliffs. Trimmer, Fl. Norf. (1860), 170. Cley. W. Rose in Bot. Guide. 1805.

NORFOLK W. Co. 28.

Burnham Overy. Trimmer. Fl. *l.c.*

Reported also from Notts, Dorset, Somerset, Scotland. Sand dunes Moran and Arisay. W. Inverness. Ex. Club. Rep. 1890. 501 (1896). "Planted by the owner." F. Townsend to W. H. Beely.

Distribution :—

Portugal, Spain, France, Belgium, Holland, Denmark, Sweden, Germany, Switzerland, Russia by sea, Siberia, Baikal, Caucasus.

V.

DESCHAMPSIA SETACEA, RICHTER, A LITTLE KNOWN NORFOLK GRASS.

By Arthur Bennett.

Read 27th October, 1908.

In the Rev. K. Trimmer's Flora of Norfolk (1866), p. 170, is recorded "*Aira flexuosa*, L. var. *A. montana*, With. Stratton Strawless Heath. B. G."

This refers to a record in Mr. D. Stock's copy of the Botanists' Guide of 1805, which he had written up for Mr. Dawson's Turner's own annotated copy, and which he lent to the author.

The plant seemed to have been little noticed until Mr. Baker in Journal of Botany (1866), p. 176, with a figure of the plant, recorded it and suggested its being looked for. In the report of the Bot. Ex. Club (1866), p. 14, 1867, it is mentioned "and should be looked for on swampy moors." Again in Jour. of Botany (1867), p. 72. In that Journal (1869, 265), Mr. A. G. More records its discovery in Ireland, and in (1869, 281) Mr. H. C. Watson records it as growing in abundance at Fleet Pond, N. Hants.

In 1871 I found it on Woking Heath, Surrey, and this has been followed by records in altogether 17 counties.

Hudson in his 3 ed. of his Flora Anglica (1798), p. 35, has "in *ericeto Strattoniensi* in *comitatu*, Norfolk, D. Stillingfleet."

Of this there are specimens in Smith's Herbarium from Hudson.

In the herbarium of the British Museum are specimens from Mr. Bryant (Briant) from Cawston Decoy.

*The Rev. H. Bryant was Rector of Colby, born in 1721, he died in 1799. He was A.L.S. in 1795, and discovered *Tillæa muscosa* in 1766.

I know of no records of its occurrence in Norfolk since these dates, and I have never seen it myself in the county.

The plant has been known under many names, I give those used in English books.

AIRA SETACEA, Hudson. Fl. Ang. (1762), 30.

A. FLEXUOSA, 3. Smith. Fl. Brit. 1 (1800), 85.

A. SCALIO-SETACEA, Knapp. Gram. Brit. t. 32. 1804.

A. ULIGINOSA, Don. Trans. Highland Soc. of Scot. VII. (1807), 194.

A. ULIGINOSA ,Weihe in Bœnninghausen's Prod. Fl. Monast. (1824), 25.

DESCHAMPSIA DISCOLOR, Roem et Sch. Sys. ii. (1817), p. 686.

DESCHAMPSIA SETACEA, Richter in Plant. Europ. i. (1890). p. 57.

This should be sought for again ; its chief difference from *D. flexuosa* is its long acute ligule, the smooth sheaths, and according to Babington the "pedicel of second flower quite equalling half its length," while in *flexuosa* "pedicel of second flower less than quarter of its length."

Besides these technical characters it grows on swampy heaths, the leaves are nearly all radical and quite subulate, and very numerous, and it has a less graceful appearance than *flexuosa*.

The specimen figured by Knapp was sent from Forfar Heath by G. Don of the Dovehillock near Forfar, some time before 1804. The figure t. 1733 in English Botany, 3 ed. (1872), p. 68 is very good. Syme makes it a sub-species of *Aira flexuosa*, L.

* Biog. Index of Brit. and Irish Botanists (1893) p. 26.

VI.

NATURAL HISTORY EXPERIENCES IN BRITISH EAST AFRICA.

By Gerard H. Gurney, F.Z.S.

Read 24th November, 1908.

On December 26th, last year, that is 1907, I started on a shooting and Natural History Expedition to British East Africa, and I hope this evening to be able to give you some account of all I did and saw there. Many of my notes are taken from the journal which I made a point of writing each evening in camp, and it has been a little difficult to string them together consecutively for this paper; what I shall read to-night will be a general account of the Natural History, the scenery, and the various tribes I came in contact with, and I hope that at some future date I may be able to read a special paper on the Collection of Birds I made, which really formed the most important work I did there: though in a country like that, where all orders of Natural History are developed so highly and where one is daily seeing and finding creatures of whose existence one has merely read of before, or whose existence was previously unknown to science, it is a little difficult to specialise and one wanted to collect *everything*. my chief difficulty was to know *what* to collect, what to leave behind and what to keep; one was so tempted to shoot the large gorgeously-coloured Weaver-bird in preference to the little dingy coloured Warbler hopping in the grass, or to catch some great scarlet and black Swallow-tail Butterfly, three times the size of our *Papilio machaon*, instead of taking the little brown *Lycaenid* flying near, the one being probably common and well-known, the other rare and obscure, and

possibly a new species. However, I managed to bring home besides a large collection of birdskins, some 300 butterflies, thirty or forty animals' heads and skins which I shot, together with a lot of reptiles, plants, eggs and curios and one or two rare live animals and birds which I shall have something to say about later.

After a fortnight's busy preparations, I joined my two friends, who I was to go with, at Marseilles on December 26th, and embarking on the German steamer "Adolph Wœmann" after an uneventful voyage arrived at Mombassa on the East African coast on Wednesday, January 14th, 1908.

Mombassa is the main port for Eastern Equatorial Africa and is a very picturesque looking town built on an old coral island, amidst groves of feathery cocoanut-palms and banana plantations, and one can well understand how not so very long ago, it was one of the big centres of the slave-trade, for which its numerous rivers and creeks running inland in all directions were very suitable. The population is of the most mixed description, European officials, prosperous Indian traders, semi-nude natives of various tribes and karki-clad English sportsmen all intent on their different occupations: the town itself is a curious mixture of modern European-like buildings and native reed-huts with up-to-date post office, station and hotels, while the luxuriant growth of the tropical trees and shrubs must be seen to be believed; splendid butterflies and gorgeous birds add to the interest of the scene and I felt that I should like to spend a long time in such an attractive place, though it was too overpoweringly hot, with the curious damp heat of the tropics, to be really pleasant.

Mombassa also forms one terminus of the Uganda Railway, which stretches six hundred miles inland to the shores of the Lake Victoria Nyanza, the greatest of the African Lakes. We spent three days at Mombassa which were chiefly occupied in getting gun and rifle licences, seeing our big luggage through the customs, and settling other formalities which have to be gone through, and beyond catching a few butterflies in the public gardens, I was able to do no collecting of any sort. At length on the 16th of January, we took our places in the

funny little open train en route for Nairobi, three hundred and twenty-five miles away ; this journey takes a day and a night, and to a stranger from England, who like myself, was seeing tropical Africa for the first time, it is indeed an amazing and astounding journey.

For the first fifty miles or so we passed through magnificent tropical woods of enormous trees, chiefly composed of Cocoanut Palms, Bananas, and Mangoes with their splendid dark green leaves in many places brightened with bushes of flowering shrubs and openings in which were picturesque native huts and villages, while gorgeous birds flew quickly from tree to tree ; we crossed over many small rivers and ravines, and then the aspect of the country gradually changed and we got into rolling down-like country covered with thick bush and scrub in which the most characteristic features were the tall sickly looking Euphorbia trees, and queer shaped Baobob trees looking like huge inverted carrots ; but it would be tedious to go through all the varied scenery we passed on that journey as we sped over bare sandy plains, through dense forests, across undulating bush country ; pulling up at a little wayside station every twenty miles or so.

When about 180 miles from Nairobi the train enters the vast rolling Athi Plains which are great stretches of sandy country with hardly a tree to be seen anywhere ; here, owing to the openness of the country, game, and by game I mean, many kinds of wild animals, may be seen in incredible numbers, feeding on either side of the railway line, for the Government has, very rightly, made certain large tracts of country into sanctuaries or game-reserves, within whose precincts no animal may be killed or shot, and the Uganda Railway passes through one of the best known of these reserves ; and for almost one hundred miles, the traveller may, from the windows of his railway carriage, enjoy the extraordinary sight of large herds of wild animals, which are seldom seen outside Zoological Gardens, feeding freely and without fear, close to the railway line ; these herds of game may be counted not in one and twos but literally in hundreds. I do not think amongst all the wonderful things I saw in East Africa, anything interested me more

than that journey through those Athi Plains ; and when about 7 o'clock in the morning we suddenly saw seven enormous Giraffes cantering slowly away from the line my enthusiasm knew no bounds.

For three or four hours we were continuously passing huge herds of Zebras and Hartebeeste who often merely lifted their heads to gaze at the passing train and then resumed their feeding, the stately Grant's Gazelle, the more gaily marked Thompson's Gazelle mingled with the Zebras, whilst a few Wilderbeeste galloped off in a cloud of dust and frightened a pair of Ostriches which until that moment had paid little or no attention to the passing train ; it is exactly like some enormous Zoo turned loose, and the great difficulty is to realize that they *are* all *really wild* ; before I left England I had been told of the extraordinary quantities of game to be seen from the railway line, but I had never imagined it could be anything approaching the reality ; so this wonderful panorama continues until Nairobi is reached, and here we got out of the train with all our baggage for it was from Nairobi we were to start on our first shooting expedition.

Nairobi is, without exception, the ugliest town I've ever seen ; it is a collection of tin and corrugated iron shops and houses, a bank, a station, and a church, with various Government houses and official buildings, and it has been placed in the middle of open country, on ground which four years ago was teeming with Lions and Leopards, in fact, only a few weeks before I arrived, a large Leopard was seen calmly walking down the main street. We stopped at Nairobi three days, in which all the arrangements for our "saffari" or shooting expedition were made, porters engaged, donkeys bought and stores and supplies arranged, and early on the morning of January 21st we set out, actually to begin our journey into the wilds of Africa, and as we rode out of Nairobi at about 5 o'clock in the morning I wondered what fate would have in store for us and what adventures would have befallen us before we returned to houses, people and civilization.

Quickly leaving the town behind us we proceeded in an easterly direction and before a couple of hours had passed

seemed to have left every trace of civilisation far behind. For the first six or seven miles we rode across wide stretches of sandy plain covered with short grass and as we passed a small hill suddenly disturbed a pair of enormous Ostriches, who scudded off at our approach, the cock with his splendid black and white feathers spread out on each side of him like a sail. On the horizon we saw herds of Zebras and Hartebeeste, but L. was anxious to get to our first camping ground as soon as possible so we did not bother about them, but rode on and presently came to a small ravine which we crossed and then followed its course for some little distance further until it was met by a river with some overhanging cliffs and big trees. and here was to be our first camp, very soon after we had arrived all was confusion, tents being put up, donkeys tethered, stores arranged, and large fires being lit all round the camp to protect us from Lions and Hyaenas at night, but presently order came out of the chaos and very soon I was sitting in front of my tent watching the busy scene in front of me, which also seemed to interest a solemn old Vulture who sat on the top of a dead tree close to us and wondered what all the fuss was about. The view in front of our camp was magnificent: looking right across the yellow plains, dotted with moving herds of Antelopes, to a blue line of distant mountains many miles away, and beyond that again a single snow peak was plainly visible in the clear air, this was Mount Kenia one hundred miles north.

I suppose every one knows the geographical position of British East Africa. German territory meets it on the south, while the kingdom of Uganda bounds it on the west; in most places the climate is delightful, although, in the middle of the tropics, the elevation is so great, that except in the dense forests and near the low-lying coast, the air is fresh and invigorating and there is often a breeze; the sun, of course, is all powerful and even on a cloudy day it is not safe to go out without one's pith helmet on. The rainy season is generally supposed to begin about the middle of March, and then indeed the country must be beautiful, all the dry arid plains covered with long green grass, whilst I was

told the flowers at that time are wonderful; there was but little rain the whole time I was in the country, we had a few tremendous thunderstorms when one thought every tree around one would be struck and one sat in one's tent and trembled, and a few tropical down-pours of rain which soon cleared up and left everything much freshened up, otherwise the weather was of the most perfect description: the nights and early mornings were often extremely cold, but directly the sun got up it quickly became very hot though not often unpleasantly so. It is only of recent years that East Africa has been at all opened up or anything known of the interior, the railway is but five years old, the town of Nairobi very little older; fifteen years ago I suppose there was hardly a white man in the country and even now much of it remains to be discovered; it is a country still in its infancy, its aspect, its animals, its forests are what they were thousands of years ago and the Rhinoceros and Hippopotamus seem like living relics of a pre-historic age; although much Natural History work has of late years been done there is a great deal still to learn, and new species are constantly turning up; my great hopes to discover an entirely new bird were not realized though I shot many very rare and interesting species; the majority of which at the time were quite unknown to me.

I suppose no one ever forgets their first night under canvas, far from civilization, on one of darkest Africa's greatest plains; certainly I shall never forget mine: let me try and describe one of our typical camps, we always, of course, had to pitch our tents near water and, if possible, under the shade of some big tree, and every evening just before dark there was constant coming and going of porters with water, or firewood some of the men would be busy cooking our dinner, others attending to the skins and heads, others seeing to the donkeys, while many would be lying idly about, often singing, constantly laughing, especially if "master" had shot a good "head" and there was plenty of meat in camp; then the dinner while we eat a choice steak of Gazelle shot that morning and watch a glorious evening sunset, the talk over the day's sport by the camp fire while gradually darkness comes

on, and one loses the shapes of the palm-trees on the river bank, and the stars suddenly appear with the marvellous brilliance which no one who has never been in the tropics can understand, and the African night with all its mystery is upon us, and we watch the dancing fireflies for a time before turning into our tents and beds. We only spent one night at this first camp, as we were anxious to get further afield as quickly as possible, and long before daybreak the following morning we were astir and after a toilet of the simplest description and breakfast outside our tents by the light of a candle, the tents were struck and in a very short time each man had his load made up and was ready to start.

Our cavalcade and mode of marching from one camp to another was each day much the same ; if we came to a good place for game or collecting we would stop there three or four days and then move on perhaps twenty miles further, and so in this way we got over a great deal of ground and had a great variety of camps ; our " saffari " when we moved camp was rather picturesque ; L. and I always rode some way in front, each keenly on the lookout for game ; though as a rule we made a practice of not doing very much shooting when marching from one camp to another, as it always meant a long delay ; we were each closely followed by our gun-bearers, carrying his master's rifles and gun, then came our other servants with all the usual impedimenta of a Natural History expedition, butterfly nets, spare guns, collecting apparatus, etc., while behind them followed in a long straggling line our fifty black porters, each carrying a 60-lb. load of baggage on his head, for Government will not allow any man to carry more than this, while the vanguard of the procession was formed by twenty donkeys also well loaded with tents, luggage and food.

Our camp that night was near a small hill called Dony-o-sambuk, very prettily situated under a grove of big Mimosa trees, and as we were now beginning to get into a good game district we decided to stop there for three days ; this suited me well and I was able to shoot a good many interesting birds, and also catch a lot of the magnificent big Papilio

butterflies which were common here ; but before going further I would like to say a little about the different Antelopes we found in this country.

There are three species of Antelope which live on these plains which we were now crossing and two species of Gazelle. The Antelopes are Coke's Hartebeeste (*Bubalis cokei*), Wilderbeeste (*Connochoetes albojubatus*) and Eland (*Taurotragus livingstoni*). The Hartebeestes or Kongoni as they are commonly called, are much the commonest, they go about generally in large herds, and take a lot of killing ; there are two other species of Hartebeeste in East Africa but this was the only one I came across ; they have a long ugly face surmounted by horns which go straight up and then branch out V shape ; their flesh is rather coarse and unpalatable though we were often glad enough to eat it as one soon learns not to be particular when one has to depend on one's rifle for one's dinner ; it is an extraordinary sight to see a herd of frightened Hartebeeste galloping, they go at a great pace, springing along in leaps with all four feet off the ground at one time; except perhaps for Zebra. I saw more Hartebeestes than any other animal, and often their numbers on the Athi Plains were incredible.

The white bearded Gnu (*Connochoetes albojubatus*) or Wildebeeste as it is called in East Africa, also lives on these vast sandy plains, though it was not until I reached a place called Kallima Theki that I saw any quantity of them, but here there were generally two or three large herds about and I was able to shoot a couple of very fine bulls, one indeed carrying the record head for the year ; they are odd looking brutes, these Wildebeeste, more like a Buffalo, at a little distance than anything else, they live right out in the open plains and will often stand motionless staring at one until one gets within 400 yards or so of them, then they give a whisk of their tails and go off in a lumbering sort of gallop and perhaps will not stop again until they are nearly out of sight ; they are a slaty-grey colour with darker stripes and fine spreading horns.

The third species of Antelope which we shot going across the Athi Plains was the Eland (*Taurotragus livingstoni*), the

licence only allows one bull to be shot by each person and I was lucky enough to get a good one, after a long and rather exciting stalk; I was returning to camp one morning when news was brought that there was an Eland standing near some rocks a mile away; sure enough I soon "spied" him standing in the shade of a small single boulder right out on the plain; it was impossible to shoot him from where we were as the boulder was directly between him and me and hid all but his head and the end of his back. so we lay down flat, and crawled round to get a clear shot the other side; when we got there we found he too had changed his position, and moved further round and that the stone was still between us. I daren't move any more for fear he should see me as there was no cover at all, so the only thing to do was to wait, and trust he'd soon shift again; but not a bit of it, he stood there, lazily twitching his ears and tossing his tail, while we lay on our stomachs, the hot sun pouring on to our backs. for nearly an hour, at last when I was nearly on the point of giving it up he gave a kind of snort, and slowly walked from behind the stone giving me a splendid shot at 300 yards. I fired and smashed his shoulder and another shot finished him; he was a splendid old bull, seventeen hands high I should think, with a beautiful head and there was much rejoicing in camp that night over so much meat, the boys sitting round the fire laughing and singing until I was obliged to get out of my tent and tell them not to make so much noise.

After spending two days near Dony-o-sambouk, where my friend shot a pretty little Antelope called "Chandler's Reed Buck," which is not very common, we marched down to the Athi River which joins the Thika River; here the whole aspect of the country was different, undulating hills covered with bush and many different species of shrubs and trees took the place of the bare plains we had previously been crossing, while directly one gets into the vicinity of water, the vegetation becomes at once luxurious; the scenery at this camp was beautiful, either side of the river was a broad belt of thick bush with many splendid trees and flowering shrubs, palms of two or three species, and a kind of large Tree-fern interlaced with

creepers and fibres, grew extravagantly, their broad feathery leaves being reflected in the clear pools and depths of the river, though the densely thick undergrowth often made getting down to the water's edge difficult; there was a very conspicuous shrub growing in abundance here, it was something like a laurel with large dark green leaves and clusters of brilliant scarlet berries or fruit which my boys eat with great enjoyment though to me they seemed hard and tasteless. There was also a bush growing about twelve feet high, covered with pale yellow flowers with a very sweet smell, and many others equally beautiful whose names I did not know. On the rocks by the river a beautiful blue Lizard was common, about twelve inches long, the skin of its throat was bright pink, and it could inflate it at will, while the pools were alive with Crocodiles, enormous Turtles, and Water Terrapins of certainly two species; I caught a little Crocodile in a landing net and kept it alive in a basin for several days, it was about eighteen inches long and fed freely on small bits of raw meat.

Most animals require to drink at least once a day and so a river generally means game, and we got a lot of nice things while we were at this camp; Impalla, a very pretty graceful Antelope were common, while the stately Waterbuck were not scarce; occasionally in going through the thick bush by the river we would disturb a timid Reedbuck from his midday siesta, and he would go bounding away in a series of enormous leaps unless a lucky bullet stopped him.

We were always keenly on the look out for Rhinoceros, but so far, although we had seen fresh traces we had not come across any; in fact in this open bush where we then were we might see anything, Lion, Buffalo, or Rhino, all might be met with at any moment, and I never went 100 yards from camp without a "boy" carrying my .404 Express.

This camp was a splendid place for birds, though one shot many which fell into the thick bush and could not be collected; large Hawks of two or three species were always flying round the tents to see what they could pick up and were so tame that they would swoop down and carry off the dead body of a bird which had been skinned and thrown a few yards away.

Great big black Hornbills (*Bucorax abyssinicus*) used also to come quite close to our camp; at a little distance they look like large Turkeys with their curious red whattles ; in the trees by the river were birds of all descriptions, gorgeous Bee-eaters, Fly-catchers, azure Kingfishers, lovely little Doves of different sorts, innumerable Shrikes, noisy Bulbuls, Bush Thrushes, and innumerable others, while on the river the most interesting species was the African Darter (*Plotus laivallanti*), which is perhaps nearer to our Cormorant than anything else, it has a long thin neck and head and sharp beak and when swimming sinks its back so low that only the thin head and neck are to be seen above the water, consequently the natives call it the " Anhinga " or Snake Bird.

We stopped four days in this place, shooting and collecting all the time, and on January 30th moved on to a camp some twenty miles further east and pitched our tents under a grove of enormous Acacia trees; in one of these trees there was a large colony of Fruit Bats, extraordinary creatures as big as kittens, with a tuft of white fur sticking out each side of their heads like cotton-wool. They hung all day head downwards from a branch, and if we went near them would turn their faces right round and look at us. The following day we had a long march as our next camp was to be on another bend of the Athi River some twenty miles away from our previous one. and I cannot do better here than quote from my journal the account of the day's sport.

" Soon after leaving camp we had some difficulty in getting the donkeys, laden with baggage, across a small stream through dense masses of Papyrus and Giant Bulrushes twelve feet high, and many of the loads came off in the water. cartridges, stores and food all getting very wet. By seven o'clock it was fearfully hot and riding through miles of tall grass over which one could barely see and which completely hid the walking porters was trying work ; crossing a small river much overgrown with big trees and fibres we came upon a large troop of Monkeys of all sizes, which rushed screaming away and I was not able to shoot one ; about ten minutes later we suddenly saw four Giraffes, apparently two cows

with calves, browsing quietly on the tops of the Mimosa trees and totally unconscious of our presence they were not more than five hundred yards away and were a beautiful sight as they moved slowly about from tree to tree, and we sat and watched them a long time. Almost directly after, going through open bush country, we saw our first Rhinoceros and great was the excitement; he was standing in the long grass the other side of a ravine and he 'winded' us directly and stood for a moment looking at us in an undecided sort of way. L. said he was a small one and not worth shooting so we watched him as he slowly trotted off into the thick bush and we rode on wondering at the fact that we were really in the heart of Africa in the home of the Rhinoceros and Giraffe.

"We passed several native villages, merely collections of mud huts surrounded by a thorn bonga or fence and all hidden away in the bush so that unless one walked right on to them one might appear to be miles away from any human habitation; three of the women came to pay us a visit in camp that night, fine upstanding creatures, each with a little naked baby slung on her back: their heads were shaved bare and their arms and legs were ornamented with large bangles of brass, while they wore many necklaces and chains and short skirts of dried skin. We reached the place where we were going to camp about 2 o'clock, and while the tents were being put up I took my gun and strolled down to the river, surprising on the way a party of enormous Dog-faced Baboons; they stood up on their hind legs just like men and looked at me and then ran off barking.

"Huge Turtles were floating about on the river and we caught some with a piece of meat tied to the end of a string. The butterflies here were magnificent, numbers of the Neptis genus, a splendid black and green Papilio, a Charaxes of a pink and white colour and very large, also a lovely golden coloured Thecla with very long tails, and two or three beautiful yellow Butterflies, and flying everywhere in the long grass was an insect much like our *Melanargia galathea*, which was in the greatest abundance, and other orders of insects were wonderfully represented, mantises especially being very varied

and fine, while one longed to be able to collect all the splendid Grasshoppers, Diptera and Beetles which we were constantly coming across."

We had now got into regular 'Rhinoceros ground,' and were constantly on the look out for them; the country was very pretty and undulating, with hills and ravines, by the rivers splendid trees, tropical creepers and thick bush; away from the water, wooded, open and park-like with the invariable Thorn and Mimosa trees, and everywhere the long grass, in many places up to one's middle, which made walking very difficult; this is the home of the Rhino, here he lives, feeding on grass and the tender shoots of a small species of Euphorbia tree, lying down in the shade of a bush during the heat of the day, and wandering about in the cool of the evening, feeding and, in my experience, charging the unwary sportsman. My first encounter with Rhino was anything but pleasant: I was some twelve miles from camp, and had given my rifle to one of my gun-bearers to carry for a moment, while I was collecting some small larvæ off a bush, my mule was grazing near and my other 'boys' were lying down under a tree a few yards away; suddenly I heard an extraordinary noise between a grunt and a roar, and looking up, I saw a huge black mass rise up behind a bush not twenty feet in front of me, and two enormous Rhinoceroses came straight for me, at a sort of gallop, with their heads down and looking as though they meant business, my man with my rifle and my other 'boys' with one yell, bolted, leaving me perfectly helpless, without a gun of any description in my hands; I stood perfectly still, frightened out of my life, and as the brutes came straight for me I thought my last moment had come. But when they were within ten yards of me, my mule suddenly brayed and they heard it and turned away from me in the direction of the noise and disappeared into the bush; never have I felt so relieved in all my life! I think they must have been a cow and a calf, which are always worse when enraged, and no doubt they were enjoying their midday siesta when they got our wind and promptly came to investigate the cause; after this excitement we rode on and I shot a Hartebeeste which I left

as a 'bait' for Hyænas and Vultures, meaning to return next day to see what was on it; near camp I was much interested in watching through my glasses a pair of Secretary Birds (*Serpentarius secretarius*) walking about and evidently hunting for snakes; I saw one or two nearly every day but they were shy and not easily approached, running quickly into thick bush if they saw any one approaching.

"Among the birds which I got in this locality was a Honey-guide (*Indicator indicator*), these birds have the remarkable habit of leading one to a place where there is a swarm of bees or honey, hence the name 'honey-guide,' they fly from tree to tree chattering incessantly, and endeavouring to entice one to follow their lead: if one follow the course it takes, it will stop suddenly at a certain tree and become quite silent, watching one intently the while, as much as to say: 'There is the honey, take it out, and leave some for me!' and sure enough, if one care to look for it, a bees' nest will be found near by, in the ground or in the hole of a tree."

After two days' more travelling we came to the Thika River and had a beautiful camp by the water's edge, and in places the surrounding country was quite rocky with occasional stony kopjes 100 feet in height. It was at this camp that I shot my two Rhinoceroses one after the other. I had killed the first one and while I was photographing it as it lay on the ground, a second one came charging up, snorting loudly, luckily I had reloaded and a bullet from my .404 Express laid him low also: the largest measured thirteen feet long and over five feet high, and the other was not much smaller, with fine horns. We saw nineteen Rhino the following day; one is only allowed to shoot two Rhinoceroses except in self-defence, and this is as well, as although in many places they are abundant, if ruthlessly shot they would very soon cease to be so: I thought they were the most extraordinarily interesting animals, seeming like relics of some prehistoric age as they wander about in tropical Africa in exactly the same kind of scenery and places as their ancestors have inhabited for countless ages. The birds at this camp on the Thika and for the following three or four days were wonderful;

three species of Vultures, Hawks without number, Bustards, Orioles, most gorgeous black and yellow Hornbills, Rollers, Bush Shrikes, Weavers, Bee-eaters, Warblers and Fly Catchers, and the beautiful little Sunbirds (*Nectarinia*) which, with the sunlight flashing on the metallic greens, scarlet and gold of their plumage, hover like moths as they suck the nectar from the long tubes of the flowering shrubs. Among the woods were tall dead trees, bare of bark, having been killed by bush-fires many years ago, these attract many Woodpeckers of different sorts who make the dry wood resound with loud tapping sounds; and when the Woodpeckers have left, glossy Starlings (*Lamprocolius*) of wonderful metallic purple and green lustre, come and go, uttering at intervals strings of discordant screeches that set one's teeth on edge. From the branches of the tall gum-trees which hang over the river's edge are suspended the extraordinary nests of all shapes and sizes of the Weaver Birds, especially of the Widow Weaver Bird (*Vidua principalis*). In the breeding season the males of this species develop tails sometimes a foot long, it was amusing to watch one of these birds in flight from one point to another, he really looked as though he would never get there, so weighed down does he seem by his long tail, and endeavouring all the time to keep himself up by a series of odd jerks.

But it would be wearisome if I went on telling you of all the things I saw and shot day after day during this part of our "safari," of the variety and beauty of the scenery we travelled through, of the animals we shot, and of the many amusing and sometimes trying adventures which befel us until we arrived on Thursday, February 20th, at Lake Naivasha; this magnificent bit of water which is about four hundred miles from the coast, is nearly eleven miles long and six broad, with two or three small islands near the south end; on the west side of the lake good sized hills and mountains slope gently down to its shore and tropical forests of dense jungle border its northern end. The lake is fringed nearly the whole way round with dense banks of Papyrus, in many places twenty feet high, while beyond this, the water is covered with the most beautiful blue and purple Water-lilies,

and many floating water plants, one especially being very noticeable as it had a small bright yellow flower, and a small bay, where the water was covered with this weed, looked quite golden. The pools at the north end of the lake are full of Hippopotamuses which, next to the Elephant, is the largest animal inhabiting the African continent; very extraordinary do they look, as they only keep their pink looking eyes and nostrils above the water, sinking and rising again to blow every three minutes or so; during the day we used to hear them booming and grunting, but at night they made no noise, as they are out on the banks of the lake feeding on the grass and riparian vegetation: the "Hippo" is supposed to be of rather an inoffensive disposition and is not looked upon as a dangerous animal, all I know is that one came for me one fine morning looking very nasty; I was hiding up in a little floating mass of Papyrus reeds as I wanted to shoot a Pelican; it was in deep water a good way out on the lake and there was just room for me to hide, the whole bunch of reeds not being two yards square, suddenly an enormous Hippo's head appeared out of the water and after steadily gazing at me for a moment or two, swam slowly in my direction: when within ten feet, he opened his huge jaws and gave a loud sort of snort, and I began to think I was going to be reduced to matchwood by one snap of those great tusks or at any rate be drowned, as my tiny island was being rocked violently from side to side by his movements in the water; luckily I had my big rifle with me and when he was quite close I rammed it right down his throat and pulled the trigger, that finished that Hippo! The following night a large Hippo ran amuck through the camp, going clean through my gunbearer's tent, why he didn't trample the man to death I can't think! and then charged the tethered mules; it was pitch dark and one could see nothing, only hear this ponderous brute like a steam roller crashing through the camp. One which I shot was so large that a "boy" was able to cut a hole in its side, crawl in and entirely disappear from view inside the animal's body, to emerge again a few moments later devouring raw bits of still quivering meat.

But to me the chief interest of Lake Naivasha was the extraordinary abundance of Waterfowl : Pelicans, Flamingoes, Herons, Jacanas, Geese, Egrets, Grebes, small "Waders" of all sorts, besides many species of Duck and Snipe, all inhabit this, at present, secluded and little known lake, while the great chocolate and white Fish Eagles (*Haliaetus vocifer*) fly continually over its placid waters. At the east side where there is no Papyrus, and where the grassy plains slope to the water's edge, Gazelles, Zebras, Waterbuck, and other game come down to drink, but there are no Rhinoceros at Naivasha, neither did we see any Lions. At the south end of the lake is an extinct volcano called Longonot, which appears to be of very great height; the whole of the Naivasha valley is volcanic by nature and also in appearance. I climbed to the top of Longonot and was well rewarded for my pains, the view from the summit being perfectly wonderful; a magnificent panorama of mountain, forest and plain was spread out before my eyes many thousands of feet below. Descending into the crater I found its sides clothed with a mass of ultra-tropical vegetation, huge trees strung together by fibres and flowering creepers, in places so dark that the sky was only indicated by twinkling stars of blue through the interstices of the leaves, and where the great tree trunks and rotten boughs were covered with wonderful forms of moss and lichen and occasional orchids; at the bottom were large flocks of Guinea-fowls which are excellent eating and made us many a good dinner.

The flowers and shrubs which we met with round Naivasha were particularly striking and beautiful, large pink and white Amaryllis Lilies grew in many places, and a pretty yellow Sunflower also was very common, while masses of bright pink Phlox flourished everywhere; the common Red-hot Pokers of our English gardens grew in the thick scrub and many others of whose names I am ignorant, and we found some fine Ferns also growing near the lake.

On March 6th, G. and I started off very early in the morning, intending to row right across the lake and make an exploring trip into country the far side. Tents, ammunition and

sufficient stores for a week were packed into the big heavy native boat and with our gunbearers and four stalwart savages to row us we were very heavily laden indeed, and progress across the lake was slow, though it was far from dull, the immense flocks of water-fowl all round us and a flight of crimson Flamingoes being of sufficient interest, while constantly a great pink head with twitching ears and little eyes appeared above the water, as a curious "Hippo" came to investigate us; all went well until about 3.30 in the afternoon, when we were three-quarters of the way across the lake, and then suddenly the wind sprang up, the rain came down in torrents, and the water, which till then had been perfectly calm, quickly became very rough, and great waves threatened every moment to capsize us; all our stores, cartridges and tents were wet through in no time, and I began to be seriously alarmed that we should be upset, the boat being so overweighted; however after a good deal of hard rowing we got close in shore, only to find a dense wall of Papyrus reeds nearly twenty feet high growing all round that side of the lake which completely prevented us from landing there, neither could we see any land beyond. We rowed on and on, in a hurricane of wind, looking in vain for an opening in the Papyrus through which to force the boat; for over an hour we rowed until we saw a grove of big trees on a small island right in the middle of the reeds; this at any rate meant a solid bottom, and as it was getting very late and was nearly dark I determined to try and land there for the night; we had then, with axes, to cut a pathway through the Papyrus, to enable us to drag the boat through; this was tremendously hard work and the heat was intense and it took a long time before we reached the trees, the tops of which we had seen from the water: these, as I had expected, grew on a small island, but it was so thickly overgrown with an almost impenetrable tangle of luxuriant tropical vegetation, covered with the most amazing creepers and traversed in all directions by Hippo paths, that even then we had the greatest difficulties in pitching our tents, and altogether spent a most unpleasant night, being short of food,

the mosquitos being unbearable and the grunts of the Hippos all round us making sleep well nigh impossible; however the following morning we were none the worse and the wet stores and tents were soon dried by the sun and it was not long before we were all packed into the boat again, and after some four hours rowing found a good landing place higher up the lake.

We had a fortnight's *most* interesting journey into lovely country this western side of the lake and I only wish I had time to-night to mention all the interesting creatures we saw and shot, let alone the magnificent scenery we went through; in my traps which were set every night, I used to catch many small mammals, Rats, Mice, etc., and we also saw and shot Hyænas, Jackals, Serval, and one or two small Cats. Of Batrachians, the most interesting find was a beautiful Frog, a species of Tree-frog; they used to sit on the tall stems of the Papyrus reeds and were of a very pale grey colour, their throats and under parts being brilliant rose-pink. I collected a dozen of them, but they were very fragile and although I took endless pains with them, the constant travelling was too much for them and one by one they died: however I was luckier with the Giant Snails which I collected on this part of my trip, and which I successfully brought back to England alive.

I have not yet made any mention of the various tribes we met, and though it is impossible in a general paper of this description to give any detailed account of them, or of their very interesting habits and customs, I should like to mention a few facts about the Masai tribe which we came a good deal in contact with at Naivasha. The Masai were the old fighting race and hereditary rulers of this part of Equatorial Africa in days gone by, terrorizing their neighbours and looting from the weaker tribes indiscriminately; they are divided into several sub-tribes, each of which has its particular device painted on the oval skin shield they carry; they also carry a long iron spear and a nasty looking knife or sword. The men wear no clothes of any description, though their warriors have fine head-dresses of Lions' manes and Ostrich feathers,

and often wear many necklaces and ornaments and charms. the women generally wear a short skirt of some animal's skin. They wear nothing on their heads which they shave, but they have a curious custom of slitting the lobe of their ear and pulling the skin down until it almost touches the shoulder: in this aperture they place the most extraordinary things by way of ornament: a short bit of wood, or a bit of European money, an empty cartridge case or a bundle of string, while one fine Masai "blood" we met, thought himself no end of a dog with an old sardine tin, top and all, fixed in his ear! Many of the men stand well over six feet high, and they are a fine well-built race: all those I came in contact with were very friendly and constantly used to come to our camps and stand gaping, open-mouthed, at the white man with undisguised wonder and amazement.

Other East African tribes I met were the Wakamba, Kikuu, the Kavirondo and the Wanderobo: the latter are the hunting tribe of East Africa, they are extremely shy of the white man, and though never hostile, seem nervous of having much to do with him: small settlements of this peculiar race of aborigines may be found in the gloomy depths of almost any large East African forest; one village I came to consisted of a thorn "bonga," or fence strong enough to prevent a Lion from breaking through and stealing any of the stock: inside this zareba were six or eight tiny little round huts, built of sticks and leaves, with a small aperture by way of a door, the filth and dirt inside being indescribable. The Wanderobo are a very poor tribe, they seldom wear even the conventional fig-leaf, and are armed with a bow and some twenty arrows, and often carry a bit of rag, carefully tied up, which contains some strips of bark which they use for medicinal purposes, somewhat in the same way as we use quinine.

After leaving Naivasha we retraced our steps and went down past a place called Limoru, the Mau Escarpment, across the Kapiti Plains to a place named Kallima Theki, which was the name of a small rocky kopje or hill, thickly covered with scrub and bush, with ravines and dongas running up its sides; before I arrived no less than four Lions had been

killed here, and it was unsafe at night to go five yards from one's tent without a lantern and a loaded rifle. A friend of mine had an Ostrich Farm here and I stayed for three weeks with him, pitching my tents alongside his little two-roomed tin house, and it was quite a relief to be able for the first time since I had been in Africa, to unpack all my things and feel I had a permanent camp for awhile, as we had never before been in one camp for more than two or three days at a time; and I was able here to do a lot of really good collecting, specially of birds. When I talk of an Ostrich *farm*, put away from your minds all ideas of an English farm as we know them in Norfolk, with nice stacks of hay, and large barns and premises; an Ostrich farm in British East Africa is probably situated miles from any habitation, and often simply consists of the settler's shanty and an enclosure for his birds; but of all farming, I am sure Ostrich farming is the most interesting and I was very glad at Theki to have the opportunity of seeing my friend's Ostriches. When I was there, there were some 130 birds on the farm, and it was a most curious sight to see them go off at sunrise every morning, in two parties each under the charge of a black boy, to remain out on the plains until sundown, much in the same way as we send a flock of sheep out on to a common to graze. At night they return and walk quietly into the bonga or enclosure, where they are protected from Lions and Hyænas, by high corrugated iron fences.

As every one knows, the Ostriches are farmed for the sake of their feathers; they are clipped twice a year, the feathers are never pulled; and six weeks after each clipping the dead stumps are drawn out, which ensures the new crop coming on uniformly, and earlier than if the stumps were left in; the chicks are first clipped at about nine months old. Eggs from wild birds are found and put into Incubators, and wild chicks are also caught and reared; though on many farms there are breeding paddocks and the pair of old birds are allowed to incubate and rear their own eggs. The finest feathers are yielded when the bird is between two and seven years old, and the most valuable are the white primaries of the male, these fetch about £7 per lb. If an East African Ostrich

Farmer averages £5 or £6 per bird per clip, he is well satisfied; a good two-year-old cock bird is worth at least £27 in British East Africa. I believe the record price for an Ostrich is £1000, a man named Evans having sold a cock bird for this enormous price in South Africa.

The Ostrich's favourite food is a small species of Lucerne with a little blue flower, and at the farm where I stayed large areas of ground were being put under Lucerne, and paddocks and enclosures made, as by far the best feathers are yielded by Lucerne fed birds. Of course it is a great question whether much money can be made out of Ostrich farming in East Africa; there is no doubt that if it is to be made to pay it must be persevered with for some years before a large profit can be made.

On the little hill at Theki lived a small herd of a rare and local Antelope called Chandler's Reed-buck, a very pretty little animal which when we first came to the place were so tame and unused to the sight of a white man that they allowed one to approach within a few yards before they dashed off with a shrill whistle. On the long grass behind our tents I found several specimens of a small rare Chameleon with an orange-throat, and an enormous Python, fourteen feet long, was shot close to the Ostrich farm. Snakes were rather plentiful here, especially a dull green Snake which was fond of water, and a long black one which was very poisonous; my friend had a narrow escape from a Snake one night; he was getting into bed in his tent, when he looked down and saw within an inch of his naked foot a very deadly little Adder lying coiled up, one half step more and he would have trodden on it, and its bite is fatal in less than twenty minutes.

Large herds of Zebras, Wilderbeestes and Hartebeestes were constantly passing in front of our camp, and Gazelles would come and stare at us, while at nights one constantly heard Hyænas, shrieking and howling outside our tents, and often, too, the marvellous resounding roar of a Lion, which is a most awe-inspiring noise and not conducive to sleep. One day I caught alive a beautiful little Mongoose, about the size of a Rat and which has since become the most charming pet;

it turned out to be a rare species and had not been brought alive to England before; another interesting animal which was common on all the rocky hills round Theki, was the Hyrax (*Hyrax capensis*), they are about the size of a Rabbit and rather resemble a very large brown Guinea-pig; in East Africa there are two species of them, one living in trees and the other in rocky hills and kopjes. but the most interesting fact about the Hyrax is that it is very closely allied scientifically to the Rhinoceros. the dentition in the two animals is almost similar. While I was at Theki we had some great hunts after Cheetahs. they were not very scarce but owing to their lurking, secretive habits they are not often seen; in the day time they live in the thickly wooded dongas and ravines, coming out at dusk to stalk their prey; we shot several. and their beautifully spotted skins make a nice trophy to bring home; I also shot a Serval which is like a small edition of a Leopard, with a beautifully spotted skin and short tail, a true Cat all over with retractile claws. which can disappear at will. unlike the Cheetah's which are non-retractile like a dog's. Two species of Hyæna, the spotted and the striped, and two species of Jackal were common, but of all Carnivora the Lion is *the* animal which every white man who goes to East Africa is most anxious to see and, if possible, to shoot. I was lucky enough to do both; four magnificent Lions had been killed by P. before I got to Theki, and a few days after we arrived I had a splendid view of a fine black-maned Lion walking quietly along in the bush early one morning, returning from his night's prowl. we fired at him at once, but did not hit him, and he disappeared over the brow of a hill thickly covered with scrub and bush; here we searched for him for some time when he suddenly dashed out from behind a large stone, looking like a great big yellow mastiff, and bounded away. if one of our bullets hit him it had no effect, and we were loth to admit that we'd lost him; the following Sunday, however, we killed a large Lioness after a most exciting and thrilling hunt, in fact I am certain that there are few more exciting things in this world than Lion shooting; if one misses a cock Pheasant in England it doesn't matter, but if

one misses an enraged Lion in East Africa, the probability is that it does matter very much, however I did not miss her, and so am alive to tell the tale; every one knows all about Lions so it would be absurd for me this evening to say much about them; they are still plentiful in many places, and long may they remain so, as though every settler's hand is against them, and on account of their killing farm stock, it is often necessary to poison them, yet I hope the day is very far distant when *Felis Leo* will have been killed out in East Africa.

To me one of the chief attractions of the country was the extraordinary interest of seeing these great wild animals, Lions, Giraffes, Rhinoceroses and Hippopotamuses, in their natural ground, like living relics of a former age; animals, which one has read about from childhood and perhaps looked on almost as fables or at all events only to be seen in Zoological Gardens; in this wonderful country are daily to be seen in the same natural surroundings which they have inhabited for ages.

Lions follow the game, and we were always sure on seeing great quantities of Hartebeestes or Zebras that news would very shortly be brought of Lions having been either seen or heard near, as they prefer a young Zebra or a succulent "Tommy" to anything else, and the so-called "man-eating Lion" is happily of rare occurrence, though I was told if once they had tasted human flesh they will not touch anything else. The natives have a story of some large man-eating Tiger which lives in the big forests, but this, no doubt, is a myth, any such animal if it existed would have been discovered long ago; many people say the Leopard is more to be dreaded than the Lion, the only Leopard I saw did not appear to be very terrifying; we had stopped one morning for a short rest in the middle of the march, and I at once strolled off with my small collecting-gun for birds, leaving my rifle and gunbearer lying under a tree, I had not gone twenty yeards into the bush before a magnificent Leopard glided off the rotten bough of a dead tree, not ten feet in front of me, and slowly trotted off into thick cover; I had evidently disturbed him in his midday

siesta, for he was lying basking in the heat, and the sun shining on his coat made it look like red satin as he went off; never again, however, did I go out shooting with only a small collecting gun. This Leopard must have been of rather a cowardly disposition I think, generally they come for one without any provocation, unlike a Lion who, if you do not molest him, does his best to get out of the way unnoticed, but a Leopard is such a sneaking animal, going about his hunting in such a distinctly underhand manner; they are great nuisances to the settlers in East Africa who go in for cattle-farming, in many respects worse than a Lion; when one hears a Lion roaring, it means that he *has* fed, otherwise the tremendous noise which can be heard for miles on a tropical night, would put all the game on the qui-vive; but the Leopard never makes any noise at all at night, sneaking all round the place and looking for a hole to get in at.

On March 22nd we camped at a charming place called Bondoni, where the country was very open and park-like, with long grass and scattered trees and bushes, and deep ravines or dongas filled with prickly shrubs and densely thick undergrowth; on a patch of sand in one of these dongas we found the big round track of a Lion which was evidently quite fresh, and after some hesitation our "boys" were induced to go down into the bottom and beat out the ravine, while we stood on the top with loaded rifles ready for anything; however the Lion had evidently not stopped there, but must have gone on, for there was nothing in it except a Hyæna and a pair of sharp-eared Jackals; the following day we had a most exciting hunt after a Cheetah, which when killed proved to be a very large female, evidently suckling cubs which were no doubt living in one of the small caves in the dongas from which it was impossible to get them out.

It was at this camp that I first saw and afterwards shot some of the remarkable Jumping Hares (*Pedetes surdaster*). which are decidedly local and by no means found everywhere in East Africa, these extraordinary animals, which are very like a miniature Kangaroo, go off in a series of bounds. leaping into the air as they run away; they are not unlike tough rabbit

to eat and were a welcome change after the endless menus of Hartebeeste meat : the bird life at this camp was especially wonderful and I got several most interesting new species : on the hills three or four miles beyond our tents were patches of thick forest with beautiful open glades, and here were birds of all descriptions ; birds strange of form, of plumage and of flight. Many of them utterly unknown to me. There were Woodpeckers, and Barbets, Bulbuls and Orioles with clear flute-like notes, Sunbirds flashing like green and gold jewels as they hovered first at one flower then at another; almost more gorgeous was an exquisite little azure Kingfisher (*Corythornis cyanostigma*). There were quaint Hornbills with their big, unwieldy bills, blue Rollers and three or four species of Cuckoo, huge grey Eagle Owls, Buzzards and Hawks of many different kinds, while troops of small green Monkeys rushed screaming from tree to tree. I shot one and she fell on to the ground looking pathetically human with her tiny baby clinging to her breast. I kept the little one alive and I have him now, and a charming little creature he is, being perfectly tame and confiding. We left Bondoni on the 25th, and on the way back to Theki I shot a Zebra, a Serval Cat and a rare black and white Babbling Thrush (*Crateropus hypoleucus*).

I spent the following day in camp drying birds' skins, writing up notes and trying to arrange more satisfactory cages for the rather large stock of live animals and birds I had by now accumulated. Our native porters and boys were beginning to learn that I gave money in exchange for live creatures and they constantly used to bring me things which they had caught in snares which they are rather clever at setting, and so I had quite a variety of rigged-up cages containing some rare birds and a large miscellaneous collection of live Snakes, Lizards and Frogs : while my traps which I always kept going generally contained something of interest each morning ; one day I found a most remarkable Mouse in one of them, with a short nose and a very long bushy tail, like a squirrel : another morning a little chestnut-coloured Mongoose was caught, not much bigger than an ordinary Rat, this proved to be a rare species and I have it alive at the present time :

Porcupines were common and we constantly used to pick up their black and white quills lying on the ground, but they are very nocturnal animals and seldom seen.

Away to the right of our camp at Theki were some high wooded hills thickly covered with bush and small forest trees, with ravines running down from the summits to the plains below ; I was very anxious to explore this ground as I thought I might find some fresh animals there, and so on March 30th, I started off very early, long before the sun had risen and when it was barely light enough to see ; it was bitterly cold riding along so early, and it was difficult to believe one was in the centre of tropical Africa, and only a very few points from the Equator ; directly after leaving camp we came upon a herd of Zebra, they looked like grey striped phantoms in the misty light and let us get within fifty yards of them before they galloped off in a cloud of dust ; crossing a small stream we disturbed a savage looking Hyæna, evidently returning from his night's prowl, my gunbearer who saw him first, running off, whispered excitedly, " Simba, simba " (Lion, lion), and in the dim light I could see nothing except a large yellow looking object. I fired at it at about eighty yards and on going up to it, was disappointed to find I had only killed a Hyæna. By 7 o'clock the sun had risen in a glory of crimson and gold, and it was not long before we were shedding coats and waistcoats as quickly as a couple of hours before we had put them on, and half an hour later we were forcibly reminded that we were in the tropics and that the sun was an Equatorial one. Half way up one of the hills when the bush was beginning to open out into patches of forest, we came upon a family party of Wart Hogs or Pigs, an enormous old Sow and four half-grown young ones ; for sheer repulsiveness and ugliness the Wart Hog takes first prize, and when they charge, with their splendid tusks gleaming like a white collar round them, their tails held stiffly erect, they look most ferocious and are not at all to be lightly despised ; we left this little lot in peace and as we passed them they trotted off to safer " cover," the old Sow, followed in single file by her offspring, grunting loudly. There were some beautiful Orchids growing on the trees here, one,

especially, with little yellow and white star like flowers falling in a small cascade of colour being lovely; unfortunately the three or four plants of this species which I brought home with me died. A loud, clear, ringing note had been claiming our attention for some time, and we had vainly searched for its owner in the densely tall thick trees, with which the hill-side was covered; presently I saw a flash of crimson and green, and I shot my first crimson-winged Louri or Turacoa (*Corythaix porphyreolopha*), these birds are about the size of a Wood Pigeon, and with a most extraordinary appearance, with mop-like crests of brilliant metallic blue and green, loose fluffy plumage and long flirting tails, on each wing is a broad band of bright crimson which makes them very conspicuous when they fly; their shrill screaming note resembles that of a woman in pain, and they are most troublesome birds to the hunter, for should one of these birds perceive a human being, it raises an outcry that very quickly brings up any other Louris within hearing, all vying with each other in strident clamour. Any game within half-a-mile at once decamps. We had now got more than half way up the nearest hill and were much impeded by the long Elephant Grass out of which we were continually flushing covies of Spur Fowl or Francolin (*Pternistes infuscatus*), while tiny little Antelopes called "Dik-dik," which were not much bigger than Hares, sprang up from under our very feet and dashed away in a series of enormous bounds.

The view from the top of the hill amply repaid any difficulties we had had in getting up; to our left, stretched out a flat bit of the Athi Plains, covered with moving herds of Hartebeestes and Gazelles, in front, miles upon miles of small rocky hills, covered with bush, beyond them a range of blue undulating mountains and in the farthest distance, standing clearly defined against the azure sky, snow-capped Killimanjaro, Africa's tallest mountain, and even though it was a hundred miles away, in that marvellously clear air, one could almost see the snow sparkling in the sunlight and every ravine and shoulder seemed to be wonderfully distinct: I sat down and became lost in thought while gazing at the

stupendous panorama in front of me, when I was brought back to matter-of-fact realities by Hassan gently pressing my rifle into my hand; I looked up, and there just fifty yards below me was a splendid Impalla buck, walking slowly through the bush and followed by five or six hinds and a smaller buck; the Impalla is a very pretty Antelope of a bright foxy-red colour with graceful twisted spiral horns; seeing that this one had a good head I at once signed to my boys to remain where they were and began cautiously to crawl down the hill towards the right, in the direction in which I knew they would come, sure enough almost directly, the big buck stepped daintily out of cover and crossing a little opening stopped for an instant to listen; as my shot rang out, all the Impalla crashed away downhill, and though I knew I had not missed him I feared I had not hit him in a vital spot, however I soon came up with him, standing quite disabled with head down and hind legs straddled apart and a second shot finished him off. While skinning him it was curious to watch the Vultures assembling; five minutes before not a sign of a Vulture was to be seen but directly he was dead seven or eight tiny black specks appeared in the sky, these were joined by others, and the heavens were flecked with circling hordes, nearer and nearer they came until their dark shadows passed and repassed on the dead grass hard by; soon the smaller Neophron Vultures, ugly dark brown birds with livid pink faces, descended with collapsed wings, many alighting on the trees and bushes within thirty yards of us; they were presently joined by two or three huge Griffon Vultures and the still blacker Eared Vulture; while a couple of enormous Marabout Storks, dropping from the sky, stood patiently on the top of a tall tree, while others continued sailing overhead. Directly we had finished skinning the Impalla, ere we had retired fifty yards, down flew the whole crowd, and I have very little doubt that in an hour's time there would have been little or no meat left on that carcase.

After this we mounted our mules and rode on for a mile or two through lovely scenery, shooting on the way a Grant's Gazelle with a very good head, until we came to a long narrow

neck, or ridge of hill, proceeding along this we came to more forest, though with many open glades, and presently fell in with a small native village, well hidden in the bush; possibly it was not a real village, merely a collection of temporary habitations, as the huts were so very rudimentary, and more primitive human dwellings it would be hard to imagine; they consisted merely of withy boughs stuck round in a circle, their supple tops bent across to meet over the centre; a few leafy branches served to cover in this frame and a small aperture was left at one side by way of a door. At our approach a party of natives retired shyly into the bushes, but on being induced to come out, were not very shy but full of curiosity, especially at our clothes, which they liked to touch, every now and then drawing back in sudden panic; they were a fine well made set of savages, most of them over six feet high, the men were naked but the women had short skirts and innumerable necklaces, and brass and copper bracelets; I gave a cigarette to one of them and it was amusing to see the others crowd round; the woman I had given it to quite understood what it was for, but preferred to chew the tobacco to smoking it. I spent a long time with these charming, unsophisticated savages, so far quite unspoilt by any contact with white men, and then proceeded to go down the hill on the opposite side to which we had come up. We worked down the dry bed of a stream and here again the flowers and shrubs were of great beauty and variety, and I caught two new species of Butterflies that I had not seen before and found some of the small dwarf Chameleons, most curious creatures with bright orange throat; further along we found the ravine turned sharply to the right so as we had to get back to our tents that night, we bore left-handed and after pushing our way through some thick bush, came out on to the level plain and were able to get back to camp before it got very dark.

And so day after day this fascinating life went on: shooting, collecting, exploring, and one forgot that all too soon we should have to return to the civilities of life and leave this wonderful country. All through our journey I had to be constantly reminding myself that I really was in the centre

of tropical Africa, far from all civilization; it seemed almost like a dream, so strange and varied were the things we did and saw, and I feel I have given you but little idea of the beauties of the scenery, the extraordinary interest of the wild animals and life of every description, and the fascination of travelling in an almost unknown country where Livingstone and Stanley were the first to explore. and discover its wonders.

Too soon the day arrived on which the last Antelope was shot, the last Butterfly caught, and the last night spent in a tent, with the Hyænas howling round; then the packing up of skins and trophies and the final march to Kapiti Station where we took the train on April 28th, arriving at Mombassa the following day. Three days later we sailed for England. I must not keep you longer; one thing more I would say, if you ever get the chance, go to East Africa, you will never regret it; go and see for yourself the wonders this world of ours has to show, and remember, there is still new country to be discovered, new birds and new animals to be found, and whether you go for sport or for travel you will find that six months spent in the heart of the Dark Continent teaches you more than you will learn in England in a lifetime.

VII.

THE GREAT BUSTARD.

Observations and Remarks on some in Captivity and Attempt to Domesticate them.

By E. J. H. Eldred.

Read 26th January, 1909.

I have the gratification of placing before the meeting this evening a few observations on the Great Bustard in captivity; but would just like to preface these notes with a brief account as to how the birds came into my possession.

In the course of conversation some time ago with Mr. D. Scott Bayfield of Great Yarmouth on the attempt made in 1900 to reintroduce the birds in East Anglia, the failure of which we all so much deplore, he remarked that he could procure some if I would undertake the care of them; such an offer I readily accepted being then about to retire from official duties and would have the leisure to look after them.

In due course Mr. Bayfield obtained through his friend Mr. Banks Thompson of London and Xeres from the latter's estate in Spain five young birds which were shipped from Cadiz on 29th August, 1907. Unfortunately two died on the voyage, but three survivors reached me safely at Coltishall on the afternoon of September 12th.

I thus had through the generous action of these gentlemen, Mr. Bayfield in particular, who has taken so great an interest in the matter, a long cherished but very little expected opportunity of making an attempt at the domestication of this fine species, and the pleasure of the undertaking was enhanced by the fact that it could be tried in the County so closely associated with its history and in which the last of the indigenous British race existed.

I had prepared for their reception a run of about 8 feet wide and 30 feet long, with an additional space at an angle

of about 12 feet with movable wire net work, to enable me to change the ground from time to time, also a shelter house, the whole facing South and protected from North and East by a high wall; into this they were released from their travelling case immediately on arrival and in a few days appeared to have quite recovered from the fatigue and close confinement of their long journey, enjoying the warm sunshine, and a dust bath, the weather fortunately continuing fine and warm for some weeks after they were received.

They remained in the open at night until early in October, when heavy rains setting in, I thought it advisable to house them in the evening, as they would not of their own accord take advantage of the shelter provided, and have continued to shut them up at dusk, being fearful as they got stronger they might if frightened hurt themselves against the wire work in the dark. As it was desirable to keep them quite tame and accustom them to surrounding sights and sounds, they were placed in as small a space as possible consistent with their health.

They are fed principally on Spratt's Poultry Meal with a little grissel or greaves, barley meal occasionally, turnip tops, cabbages, lettuces (all green food they eat greedily), bullock's liver chopped small, and worms; but a piece of raw meat cut up in little bits is their favourite morsel and they will run to meet us eagerly to obtain it. They will take a small Mouse, but appear to refuse Toads and Frogs, as I found a small Toad in their run of which they took no notice, and a small Frog offered was refused, but they search for and pick up a good many insects,

The male bird has a curious way of swallowing food, on giving him a ball of barley meal or piece of bread it will be observed to pass into the throat in the usual way, but when half way down the neck it passes quite to the back before entering the stomach. I have seen a notice of this before, but where or when I cannot recall to mind; plenty of coarse grit is given and the run and house kept scrupulously clean. They drink occasionally but not regularly. They all take food freely from the hand, in fact so confiding are the hens that

on our entering the run without some dainty they expect, they will often vent their displeasure by pecking our clothing. They were really quite tame when received showing that great care must have been bestowed in bringing them up. One cannot help feeling regret and surprise that no systematic effort seems to have been made, in the countries where they are still plentiful, to domesticate them, at any rate I am not aware of any such effort on record.

The birds being young, hatched the preceding spring, we could not with certainty discriminate the sexes but judged them to be male and two females, which surmise proved correct the larger bird showing the moustachial plumes towards the close of the year and by the end of January they had grown to a length of about 1½ inches; these he lost about the middle of June and the new ones were just perceptible towards the end of November.

The wings of all had been clipped very close, but the cut feathers were replaced about the end of May, the tail feathers were much abraided, but new feathers with white tips began to replace these in the spring, the crown of the head began to show some chestnut colour in June: moulting continued quite into the summer and to the end of August quantities of small feathers were cast.

I have not noticed any very marked change in the general plumage except the tail, but I fear I am not a good observer in the matter. Unfortunately owing to some defect or injury, I think in the carpal joint, the male bird does not up to the present retain the large primary feathers of the left wing, these fall and show signs of weakness in the shaft, but it does not, I am glad to say, apparently affect his general health.

Bustards are silent birds, but on occasion emit a sort of hoarse grunt and hiss when offended, or to show their displeasure, they make a low whining or plaintive mew when alarmed or unsettled, more particularly at nightfall, sometimes towards evening they are very restless, pacing up and down their enclosures, and seem inclined to rise in flight, but compose themselves when shut up in their house for the night.

They take little or no notice of Rooks, Wood Pigeons or

Gulls flying over, but immediately detect a Kestrel, the only Hawk I have noticed here, and at once begin to show signs of uneasiness, whining and crouching; it is surprising how close they can squat to the ground for so large a bird. A Heron passing over also puts them on the alert, as they do not at present seem to make out what it is, presumably taking it for a large bird of prey. They are very much afraid of strange dogs, and will on the appearance of one, if care is not taken, dash themselves against the netting. Their power of vision must be acute, as they distinguish the object of their aversion at a long distance, when quite a speck in the air, in fact long before I can make out what is troubling them.

During the middle of the day in hot weather they are very quiet and restful and enjoy basking in the sun with outstretched wings, panting with the heat, and they usually sit all facing one way, but in wet weather they look very miserable and dejected as they stand hunched up together.

I have only observed the male bird show off twice, the first time on May 11th, again on 2nd June, and on one occasion shortly after he was very pugnacious attacking me fiercely when inside the enclosure. Of course I was very gentle with his outburst and he has not since evinced any further signs of ill temper towards myself, but finding him rather spiteful with the hens when shut up, I separated them at night. He is not nearly so familiar as his companions, these will attend me quite closely when cleaning or doing anything inside the run, following in quest of worms or insects that may turn up.

Having now had these splendid birds under close observation and personal care for over a year, I may perhaps venture to offer some opinion on the prospects of domestication. I have always been very enthusiastic and sanguine that it could be accomplished, but until one has such an undertaking really in hand the difficulties to be overcome before a successful result can be looked for are hardly realised. What remarks I have to offer will, I trust, deter no one from a similar attempt, as I rather want to show as far as possible the nature and habits of the birds and how best to meet their peculiarities

and requirements and take advantage of any little knowledge gained.

I have seen it stated that the Bustard has been domesticated but it cannot be regarded as completely so till it has bred in captivity, which it has been rarely known to do, the only instance on record that I am aware of is that mentioned in the 'Field' of 21st Sept., 1907, and which occurred in the Tyrol in the year 1860.

The chief difficulty to get over in my mind is this, they are essentially ground birds and would seem to have no fixed roosting resort, and judging from the restlessness of mine so often displayed at evening and sometimes when let out in the morning, I come to the conclusion that they would shift their ground very frequently and not return to any particular resting place even if accustomed to be fed on the spot, and one has only to observe their great wing expansion and consequent power of flight to infer to what a distance they would travel, they could of course be pinioned or have their flight feathers cut, but I am averse to this to begin with, as I consider so doing might and probably does dispirit them; as they get older and possibly more reconciled and settled to their surroundings this might be tried, the first efforts will therefore I think have to be made by keeping them entirely as Aviary Birds.

With regard to the reintroduction in a wild state—it would seem useless to turn out even young birds, strangers in a strange land, without first enclosing them for a considerable time on the ground where it is intended to release them. The distance which now separates us from their present nearest haunts on the continent—North Germany—precludes the hope of any number of immigrants frequently turning up as in the winter of 1870-71, when more than a dozen appeared in various parts of England, but were as a matter of course destroyed.

With the Great Bustards three specimens of the Lesser Bustard were most kindly sent us, these seemed to be doing well up to the end of February last, when two suddenly died, both proving hens, the survivor, which I think was also a hen, I sent to the Zoological Gardens where I hope it found a mate.

VIII.

METEOROLOGICAL NOTES, 1908.

(From observations taken at Norwich.)

By Arthur W. Preston, F. R. Met. Soc.

Read 23rd February, 1909.

January.

The first week gave a period of delightful winter weather, with wind frosts and brilliantly sunny skies, skating being very general and the ice very good. The remainder of the month was changeable, with much fog in the third week. Mean temperature was about a degree and a half under the average. Frost occurred on 19 nights in the screen and on 24 nights on the grass, the minima falling below 20 degrees on three nights in the screen and on seven nights on the grass. Altogether it was a fine, seasonable month, although the coldest January since 1897. Snow fell on five days, but to no great depth, and the total month's rainfall was .57 below the normal.

February.

This was a mild month, with a predominance of westerly winds. The first half of the month was dry, the latter part rainy. Snow fell on three days only; and frosts occurred on only seven nights in the screen, although on the grass the thermometer fell below 32 degrees on 20 nights. No great severity was recorded; in fact, no such high minimum (29.0 degrees) has been noted in February since 1883. The chief feature of the month was a remarkable thunder-squall, which occurred on the afternoon of the 22nd. About 4.30 p.m. the wind suddenly rose almost to the force of a hurricane, and heavy squalls of hail and rain were accompanied by vivid flashes of lightning and sharp peals of thunder. The storm lasted but little over ten minutes, but during that

period many large trees were uprooted and considerable damage was done by the lightning.

March.

Winterly weather prevailed on many days, with snow, and accompanied by frost, although of no great severity. Mean temperature was a degree under the normal, and there were but few mild days. Rough winds blew on several days, particularly on the 9th and 31st, but the general direction varied much, and there were constant fluctuations of the barometer.

April.

The earlier part of the month was mild, but with the advent of Easter on the 19th an exceptionally severe winterly period (for so late in the season) was ushered in. Snow fell almost daily, culminating with great snowstorms, more in character with Christmas than Easter, on the 23rd and 24th. Although the melted snow on the morning of the 24th measured .81 ins., this fall was considerably less than what occurred in many places in the south of England, where roads were rendered impassable by the depth of the snow. The mean temperature of the month was 3.4 degrees below the average, and it was the coldest April since 1891.

May.

A cheering change took place with the coming of May, and the contrast from the great snows of the 4th week of April was remarkable. The month was warm throughout, which is rarely the case in May, and the mean temperature of the month was the highest for forty years past. Warm, growing rains during the first half of the month forced on the much retarded vegetation, and the fruit blossoms were unchecked by frost, and formed a magnificent spectacle in the middle of the month. Mean temperature, which was 4.4 degrees above the average, was as much as 13 degrees higher than that of April: in fact, it was a sudden jump from winter into summer, the thermometer failing to reach 60 degrees on only three days, and exceeding 70 degrees on four days.

JUNE.

The first four days were exceedingly warm, and the air very close, culminating in a series of thunderstorms, which cleared the air, and greatly reduced the temperature. Rain fell almost daily to the 17th, though not very heavily at any time, and from the 19th the weather was very fine with a high barometer and north-easterly winds. The mean temperature of the month was slightly above the average, and the rainfall about three-quarters of an inch deficient. On the last night of this month, and on the following night, twilight was prolonged to such an extent that small print could be read out of doors till 10.30 p.m., a most unusual experience in these latitudes, even during the long days of June. Considerable difference of opinion seems to have prevailed as to the cause of the phenomena, although the view of the writer is that it was a summer exhibition of the aurora borealis.

JULY.

The anti-cyclonic conditions which prevailed during the latter part of June continued during the opening days of July, but from the 7th to the 16th frequent barometric depressions passed across the country, accompanied by very heavy rains. During this period no less than 3.40 ins. of rain fell, of which 1.80 ins, was gauged for the 24 hours ending 9 a.m. on the 14th. The last ten days of the month were practically rainless, and the weather very fine. The mean temperature of the month was in close agreement with the average, and although there were some warm days during the last week no very exceptional heat was experienced. During the month the thermometer reached or exceeded 70 degrees on 15 days, against 6 days in the previous July.

AUGUST.

This was a disappointing month. After a few similar fine days to those which closed July, the weather broke down completely, and on many days it was very cool and cheerless, with rain, although the latter was not heavy till the latter part of the month, when drenching thunder-rains occurred at times. Much cloud prevailed on many days during the month,

and mean temperature was two degrees deficient. There was great fluctuation of temperature at times, but there were very few really warm days after the first week.

September.

On September 1st the barometer fell to a lower level than had been observed since the previous February, and a cyclonic storm of a severity but rarely equalled so early in the autumn, swept across the country. Much chilly and cheerless weather followed, and on the 23rd there was a remarkable local rainfall of 1.50 ins., which large amount fell in about three hours. At the end of the month a heat wave set in, and the last two days and nights were most unseasonably warm. The total rainfall of the month was .30 ins. above the average.

October.

The abnormal heat with which this month entered, formed a strange counterbalance to the unusual cold and great snows of April, six months previously, and the hot, cloudless days and blazing sunshine of the first week of the October of 1908 will not readily be forgotten. On the first four days the screened thermometer reached 76 deg., 78.4 deg., 77 deg., and 72.6 deg. respectively, the first three values being the highest on our registers for October, the previous maximum having been 75.5 degrees in 1901. The weather continued warm till the 15th, on which day temperature again reached 70 degrees, but afterwards it was cooler. The mean temperature of the month was 4.2 degrees above the average, and the rainfall over 50 per cent. deficient.

November.

This month was dry and pleasant, with some rather sharp frosts for so early in the season, in the second week. On the morning of the 10th the thermometer fell to 23.4 degrees in the screen and to 18.6 degrees on the grass, and on the following morning to 28.2 degrees and 19.2 degrees respectively. The rainfall of the month was 1.12 ins. below the average, and there was no snow. Mean temperature was high (about 1 degree above the normal) constituting the third warm November in succession.

December.

December entered with a week of very dark and dismal weather. During this period the sun was totally invisible, and heavy clouds hung like a pall over the landscape. The weather continued mild over Christmas, but on the 27th a short but sharp snap of cold occurred, which lasted four days, disappearing on the 31st as suddenly as it had come. The ground was thickly covered with snow, but much less fell here than in other parts of England, where the snowfall was heavier and the frost very severe.

The Seasons.

The following tables show the mean temperature and rainfall of the four seasons, together with those of the five previous years, compared with the usual averages. Winter comprises the three months December to February inclusive; Spring, March to May; Summer, June to August; and Autumn, September to November.

TEMPERATURE.

Seasons.	1903.	1904.	1905.	1906.	1907.	1908.	Average	Departure of 1908 from average.
	degrees.	degrees.	degrees.	degrees.	degrees.	degrees.	degrees.	degrees.
Winter ...	41.8	38.3	39.2	39.3	36.2	38.8	38.0	+0.8
Spring ...	47.3	47.8	47.5	46.7	47.6	46.3	46.3	0.0
Summer ...	58.7	60.8	62.1	61.1	57.8	59.8	60.3	−0.5
Autumn ..	51.2	49.8	47.5	52.9	50.7	51.6	50.2	+1.4
Year ...	49.5	49.3	49.0	49.7	48.4	49.0	48.7	+0.3

RAINFALL.

Seasons.	1903.	1904.	1905.	1906.	1907.	1908.	Average	Departure of 1908 from average.
	in.	in.	in.	in.	in.	in.	in.	in.
Winter ...	3.64	5.96	4.91	7.73	6.09	6.21	5.37	+0.84
Spring ...	5.83	4.59	5.29	5.32	7.77	6.97	5.13	+1.84
Summer ...	10.54	4.70	6.05	4.96	5.74	7.30	6.87	+0.43
Autumn ...	9.77	4.98	8.11	8.75	6.57	5.94	8.38	−2.44
Year ...	29.44	21.50	22.96	28.54	26.25	25.16	25.75	0.59

The mean temperature of the three winter months was 0.8 degrees above the average. The rainfall of this period was 0.84 ins. in excess. The spring gave a great variety of temperature, the coldness of March and the severity of April being counter-balanced by the unusual warmth of May, thereby causing the mean temperature of the three spring months to be exactly normal. The rainfall of these three months was 1.84 ins. above the average. The mean temperature of the three summer months was half a degree deficient, and the rainfall 0.43 ins. in excess, while the autumn, which was very fine and warm, was 1.4 degrees above the average temperature, with a rainfall as much as 2.44 ins. deficient.

The Year.

The most noteworthy features of the year were the severe thundersquall on February 22nd, the extraordinary snowstorm at the end of April, the warm May, the cool August, the great outburst of heat at the end of September and beginning of October, and the short but sharp period of winterly weather in the last week of the year. The summer, although it lacked the fineness and heat of that of 1906, was a very decided improvement on 1907, and had several fine and warm periods, particularly in the former and latter parts of June, the last half of July, and the first few days of August. The cool, rainy periods in the middle of July and during the greater part of August and in September were compensated for by the great beauty of the later autumn, which was one of the finest and warmest seasons on record. Garden fruits ripened well, and were abundant. The corn harvest, though rather late in commencing, and retarded by rain from time to time, was generally concluded in this neighbourhood by the middle of September. The total rainfall of the year was 25.16 ins., or about half an inch under the average.

1908.

Month.	Barometer. Highest.	Date.	Lowest.	Date.	Mean.	Thermometer. Highest.	Date.	Lowest.	Date.	Mean.	Hygrometer. Mean Relative Humidity. 9 a.m.	Cloud. Estimated Proportion	Rainfall. Inches.	No. of Days.	Wind. Direction. N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.	Mean estimated force
	in.		in.		in.	°		°		°	%												
Jan.	30.60	21	28.86	8	30.119	54.6	27	17.0	5	35.9	90	6.6	1.13	21	0	3	4	0	10	4	6	4	3.5
Feb.	30.66	7	29.08	29	30.008	52.0	21	29.0	3	40.6	87	7.3	2.17	19	3	0	0	1	1	5	13	6	3.2
March	30.23	14	29.16	10	29 812	61.4	24	26.0	16	39.9	85	7.4	2.51	25	4	2	5	3	4	1	10	2	3.3
April	30.37	7	29.29	24	29.920	59.6	9	28.2	25	42.9	75	7.0	2.67	19	6	10	4	2	1	2	2	3	3.8
May	30.51	27	29.39	6	29.977	77.2	31	39.8	11	56.0	72	6.5	1.79	14	2	5	1	3	5	3	10	2	2.7
June	30.39	27	29.67	13	30.070	79.0	1, 4	39.8	15	58.9	69	5.9	1.20	15	5	9	3	0	4	3	1	5	3.2
July	30.43	29	29.39	17	30.000	80.5	30	45.0	8	61.5	73	6.1	3.49	13	8	3	0	4	5	5	4	2	2.9
Aug.	30.39	2	29.44	28	29.962	81.0	3	43.0	16	59.0	76	6.9	2.61	19	8	0	3	1	1	4	11	3	3.1
Sept.	30.25	5, 30	29.16	1	29.959	76.6	30	37.0	13	56.7	80	6.1	2.91	15	1	0	3	2	4	6	9	5	3.3
Oct.	30.51	22	29.93	10	30.152	78.4	2	30.6	25	53.5	90	5.5	1.40	19	1	1	5	10	9	2	3	0	1.9
Nov.	30.43	30	29.27	22	30.027	56.8	12	23.4	10	44.7	88	6.7	1.63	16	1	1	5	8	4	3	6	2	2.6
Dec.	30.43	1, 31	28.73	10	29.920	49.0	17	22.6	28	38.7	93	8.3	1.65	26	1	1	3	4	11	5	1	5	2.6
Means					29.994					49.0	81	6.7											3.0
Extremes & Totals.	30.66	Feb. 7th.	28.73	Dec. 10th		81.0	Aug. 3rd.	17.0	Jan 5th.				25.16	221	40	35	36	38	59	43	76	39	

APPENDIX.

Annexed is a summary of the results obtained from Meteorological and Phenological observations during the ten years 1898-1907, being a continuation of the tables given in Vol. VI. of 'Transactions' pp. 342-347.

TABLE I.

Absolute highest monthly and annual shade temperature during the ten years 1898—1907.

Year.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
	°	°	°	°	°	°	°	°	°	°	°	°	
1898	56.0	60.2	63.4	66.0	66.2	74.4	76.0	86.0	89.0	68.0	60.8	56.0	89.0
1899	56.0	63.6	62.2	62.2	69.0	81.2	85.0	84.0	87.0	65.2	61.0	53.2	87.0
1900	50.2	57.0	55.4	75.4	71.0	82.2	87.2	79.0	80.0	75.0	60.6	57.0	87.2
1901	53.0	52.6	56.1	72.0	76.7	79.0	83.3	83.5	76.0	75.5	58.0	56.0	83.5
1902	52.4	54.0	60.0	65.2	72.8	80.2	83.4	77.8	73.0	65.3	60.8	56.0	83.4
1903	54.8	58.6	64.6	60.0	75.2	86.0	83.2	74.0	83.0	67.0	56.0	49.0	86.0
1904	55.0	55.0	60.0	68.6	75.2	75.6	86.8	87.6	72.0	66.2	59.0	56.0	87.6
1905	52.0	53.8	60.0	64.0	80.2	77.3	82.6	77.2	74.0	58.4	54.2	55.4	82.6
1906	52.0	49.0	67.0	72.2	73.6	78.4	82.5	91.5	03.0	72.4	60.0	52.2	03.0
1907	48.8	54.4	70.0	67.4	80.0	73.8	73.2	77.4	79.0	65.4	57.6	54.4	80.0
Extremes 1898-07	56.0	63.6	70.0	75.4	80.2	86.0	87.2	91.5	93.0	75.5	61.0	57.0	93.0
Extremes 1888-07	56.0	64.0	70.0	75.4	82.2	86.0	87.8	91.5	03.0	75.5	62.8	57.0	93.0

TABLE II.

Absolute lowest monthly and annual shade temperature during the ten years 1898—1907.

Year.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
	°	°	°	°	°	°	°	°	°	°	°	°	°
1898	29.0	22.4	22.8	27.4	33.4	36.8	40.0	44.2	35.7	37.0	29.2	26.2	22.4
1899	24.6	23.8	14.0	32.0	30.6	38.4	48.6	46.0	33.6	29.8	31.6	13.0	13.0
1900	26.0	18.4	23.2	28.0	33.0	45.8	46.8	45.2	41.2	31.5	28.0	25.8	18.4
1901	22.0	9.2	25.5	29.0	33.4	40.2	46.8	45.0	41.8	28.6	25.2	24.4	9.2
1902	25.4	14.0	26.2	29.2	31.2	36.3	40.6	39.8	38.0	35.6	29.0	26.0	14.0
1903	27.5	24.8	28.2	28.6	32.0	34.8	40.4	44.4	38.2	35.4	28.2	26.0	24.8
1904	23.2	26.2	24.2	32.8	34.8	39.8	46.2	42.0	38.0	29.4	23.0	21.0	21.0
1905	21.4	26.8	24.0	27.0	33.0	42.6	48.8	46.0	41.0	28.8	23.6	28.4	21.4
1906	26.8	27.4	27.0	28.8	31.8	36.0	44.2	43.2	34.4	32.6	29.2	15.8	15.8
1907	14.8	20.6	26.8	29.4	33.8	44.0	40.2	43.0	32.6	33.6	28.0	26.2	14.8
Extremes 1898-07	14.8	9.2	14.0	27.0	30.6	34.8	40.0	39.8	32.6	28.6	23.0	13.0	9.2
Extremes 1888-07	7.2	4.0	12.0	24.0	29.6	34.8	36.6	38.5	32.0	25.0	14.0	13.0	4.0

TABLE III.

Mean monthly and annual temperature during the ten years 1898—1907.

Year.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
	°	°	°	°	°	°	°	°	°	°	°	°	°
1898	43.1	40.8	39.7	47.3	50.3	57.0	59.5	62.6	61.5	54.2	46.3	44.1	50.5
1899	41.7	41.9	40.9	47.2	50.6	58.8	63.9	63.0	57.1	49.3	47.3	35.9	49.8
1900	38.6	37.6	38.4	46.9	50.7	59.3	65.1	60.3	58.3	50.7	45.7	44.2	49.6
1901	37.9	34.9	39.2	47.6	52.1	57.7	63.7	62.7	59.0	50.5	42.5	38.5	48.8
1902	40.5	34.9	43.8	46.8	48.2	57.9	59.7	58.4	56.3	50.1	44.0	40.4	48.4
1903	40.6	44.3	45.6	43.5	52.7	56.1	60.7	59.2	57.8	52.5	43.3	37.8	49.5
1904	38.3	38.9	40.8	49.3	53.2	56.6	64.4	61.3	56.2	51.1	42.2	39.4	49.3
1905	37 7.	40.5	45.4	45.5	51.7	59.8	65.5	61.0	56.7	44.8	41.0	39.0	49.0
1906	40.7	38.1	41.4	45.6	53.1	56.8	62.6	63.9	58.7	54.2	45.8	35.5	49.7
1907	36.8	36.4	44.0	46.3	52.4	56.6	56.9	59.8	57.2	50.8	44.1	40.0	48.4
Mean 1898-07	39.6	38.8	41.9	46.6	51.5	57.7	62.2	61.2	57.9	50.8	44.2	39.5	49.3
Mean 1888-07	37.8	38.2	41.8	46.1	51.8	58.1	61.2	60.8	57.5	49.8	44.0	38.8	48.8

TABLE IV.

Monthly and annual rainfall during the ten years 1898—1907.

Year.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.	ins.
1898	1.07	1.22	2.18	1.22	2.78	3.22	2.00	1.68	.17	2.48	3.00	2.31	23.33
1899	2.24	1.27	1.99	2.88	1.07	.89	1.87	.76	3.29	2.30	2.72	1.70	23.94
1900	2.74	2.92	1.09	1.30	1.87	2.70	1.72	4.35	.80	2.26	2.17	2.98	26.99
1901	.74	2.16	1.98	2.26	.86	1.55	1.10	.87	.80	2.07	2.38	4.14	21.06
1902	1.18	.77	1.07	1.31	4.39	2.34	2.11	3.37	1.38	1.34	1.42	1.62	22.30
1903	1.68	.34	1.73	2.52	1.58	2.45	5.37	2.72	3.69	4.21	1.87	1.28	29.44
1904	1.51	3.17	1.93	.86	1.80	.68	1.85	2.17	1.78	1.20	2.00	2.55	21.50
1905	.93	1.43	1.82	2.06	1.41	3.13	.65	2.27	2.02	4.14	1.05	1.15	22.06
1906	3.96	2.72	1.99	.66	2.07	2.31	.78	1.87	1.14	3.21	4.40	2.83	28.54
1907	1.58	1.68	1.42	3.65	2.70	2.73	1.72	1.20	.52	3.26	2.70	2.91	26.25
Mean 1898-07	1.76	1.77	1.72	1.87	2.20	2.20	1.93	2.14	1.57	2.65	2.47	2.35	24.63
Mean 1888-07	1.86	1.56	1.79	1.68	2.00	2.08	2.57	2.37	1.83	2.90	2.42	2.13	25.19

TABLE V.

Prevailing direction of wind in each month during the ten years 1898—1907.

Year.	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1898	S.W	N.W	N.E	E	N.W	W.	N.W	W.	W	E	W	W
1899	S.W	S	W	W	N.E	N.E	S.W	N.E	N.W	S.E	W	E
1900	S.W	S.W	N.E	W	N.E	S.W	N.W	N.E	W	N.W	S.E	S.W
1901	S.E	N	N.E	S.W	N.E	N.W	E	NW.	N.W	N.W	N.W	W
1902	W	S.E	S.W	S.E	N.W	E	W	W	N.E	E	S.E	E
1903	S.W	S.W	S	N.W	N.E	N.E	W	W	W	W	N.W	S
1904	W	W	N.E	N.W	W	N.E	W	W	E	N.W	W	W
1905	W	W	S.W	E	N.E	N.E	W	S	N.W	N.W	S	S
1906	W	N.W	N	N.E	N	N.E	W	S.W	N.W	S.W	W	N.W
1907	W	N.W	N.W	E	S	S.W	W	W	E	S	S.E	S.W
Prevailing monthly direction.	W	N.W	N.E	E	N.E	N.E	W	W	N.W	N.W	W	W

TABLE VI.

Number of days on which the wind blew from the eight points each month from 1898—1907.

Month.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.
January .	16	12	17	35	33	64	90	43
February	19	24	25	22	27	45	61	58
March .	32	47	27	11	45	45	52	51
April . .	26	27	42	27	24	37	55	62
May . .	52	53	30	19	34	35	40	47
June . .	31	54	33	25	32	47	44	34
July . .	34	23	28	23	19	41	73	64
August .	20	37	19	22	37	55	76	44
September	30	29	39	32	33	39	43	55
October .	19	7	35	29	54	54	51	61
November	23	21	27	36	42	34	63	54
December	15	8	42	16	47	59	70	53

TABLE VII.

Number of days on which the wind blew from the eight points in each year from 1898—1907.

Year.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.
1898	34	32	33	27	36	53	87	63
1899	32	36	40	32	46	53	62	64
1900	24	52	21	22	42	83	54	67
1901	38	43	43	43	26	44	52	76
1902	33	23	52	41	36	50	73	57
1903	35	24	29	25	56	56	87	53
1904	23	33	40	36	37	41	87	69
1905	33	36	33	17	50	57	75	64
1906	41	42	26	33	43	61	66	53
1907	24	21	47	26	55	57	75	60
Average days. 1898-07	32	34	36	30	43	55	72	65
Average days. 1888-07	32	38	36	31	40	62	66	60

TABLE VIII.

Dates of first leafing of Deciduous Trees, etc., during the ten years 1898—1907.

Trees, etc., Leafing.	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	Averages. 1898-07	Averages. 1888-07
Hawthorn . .	Feb. 27	Mch. 26	Apr. 3	Apr. 4	Mch. 23	Feb. 11	Mch. 17	Mch 12	Mch. 7	Mch. 25	Mch. 16	Mch. 18
Sycamore . .	Apr. 14	Apr. 14	Apr 18	Apr. 18	Apr. 14	Mch. 1	Apr. 1	Mch. 30	Apr. 10	Apr. 7	Apr. 7	Apr. 6
Horse Chestnut .	Apr. 9	Apr. 5	Apr. 17	Apr. 18	Apr. 10	Mch. 17	Apr. 9	Mch. 28	Apr. 9	Apr. 1	Apr. 6	Apr. 6
Lime . . .	Apr. 16	Apr. 25	Apr. 22	Apr. 27	Apr. 20	Mch. 26	Apr. 16	Apr. 14	Apr. 11	Apr. 5	Apr. 15	Apr. 17
Birch . . .	Apr. 21	Apr. 23	Apr. 24	Apr. 26	Apr. 20	Apr. 8	Apr. 28	Apr. 16	Apr. 11	Apr. 8	Apr. 19	Apr. 22
Beech . . .	Apr. 27	Apr. 30	Apr. 25	Apr. 29	Apr. 24	Apr. 24	Apr. 20	Apr. 22	Apr. 20	Apr. 27	Apr. 25	Apr. 26
Elm . . .	May 3	May 5	May 7	May 7	May 8	Apr. 10	Apr. 27	Apr. 26	May 10	May 5	May 2	Apr. 30
Maple . . .	Apr. 28	May 6	May 8	May 12	May 4	Apr. 11	Apr. 24	Apr. 20	May 6	May 6	May 1	Apr. 30
Oak . . .	May 7	May 12	May 7	May 12	May 22	Apr. 10	May 2	May 8	May 6	May 3	May 6	May 5
Ash . . .	May 22	May 25	May 15	May 20	May 28	May 18	May 10	May 17	May 8	May 15	May 18	May 14
Foliage generally complete .	June 8	June 8	June 3	June 5	June 7	June 2	May 28	June 7	May 30	June 9	June 5	June 4

TABLE IX.

Dates of first flowering of Indigenous Plants and other natural phenomena during the ten years 1898—1907.

Plants, etc., Flowering.	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	Averages. 1898-07	Averages. 1888-07
Anemone nemorosa (Wood Anemone)	Mch. 18	Apr. 2	Apr. 10	Apr. 8	Mch. 27	Mch. 5	Apr. 2	Mch. 19	Apr. 3	—	Mch. 28	Mch. 31
Ranunculus ficaria (Lesser Celandine)	Mch. 5	Feb. 26	Mch. 11	Feb. 27	Mch. 9	Feb. 9	Feb. 20	Feb. 18	—	—	Feb. 26	Mch. 3
Caltha palustris (Marsh Marigold)	Jan. 30	Jan. 8	Apr. 17	Apr. 12	Mch. 9	Mch. 14	Apr. 5	Apr. 4	Feb. 14	- -	Mch. 10	Mch. 20
Cardamine pratensis (Cuckoo Flower)	May 12	May 14	May 7	May 12	May 2	Apr. 4	Apr. 17	Apr. 26	—	—	Apr. 30	Apr. 28
Sisymbrium alliaria (Hedge Mustard]	Apr. 24	Apr. 16	May 6	May 11	May 2	Mch. 31	Apr. 22	Apr. 16	Apr. 15	May 5	Apr. 24	Apr. 23
Lychnis dioica (Red Campion)	Apr. 30	Apr. 29	May 8	May 9	May 4	Apr. 9	May 12	Apr. 16	—	May 26	May 1	May 1
Stellaria holostea (Great Stitchwort)	Mch. 31	Apr. 16	Apr. 13	—	Apr. 16	Mch. 25	Apr. 13	Apr. 2	Apr. 15	Apr. 7	Apr. 8	Apr. 11
Æsculus hippocastanum (Horse Chestnut)	May 8	May 18	May 7	May 14	May 5	May 8	May 10	May 9	May 8	May 7	May 9	May 8
Trifolium repens (White Clover)	June 10	May 21	June 1	May 29	June 12	May 26	June 1	May 31	—	June 29	June 4	May 29
Prunus spinosa. (Blackthorn)	Apr. 14	Apr. 19	Apr. 22	May 2	Apr. 22	Mch. 25	Apr. 16	Apr. 5	—	—	Apr. 16	Apr. 14
Rosa canina (Dog Rose)	June 16	June 15	June 11	June 17	June 21	June 6	June 10	June 8	June 17	June 17	June 14	June 13

Crataegus oxyacantha (Hawthorn)	May 14	May 21	May 11	May 22	May 25	Apr. 30	May 12	May 16	May 17	May 12	May 15	May 14
Anthriscus sylvestris (Wild Parsley)	Apr. 23	Apr. 24	Apr. 22	May 6	Apr. 22	Mch. 1	Apr. 21	Apr. 20	Apr. 28	May 3	Apr. 20	Apr. 21
Chærophyllum tem. (Rough Chervil)	June 12	June 8	June 13	June 9	June 5	May 28	June 2	June 6	May 27	May 26	June 4	June 3
Chrysanthemum leuc. (Ox-eye Daisy)	June 1	June 1	May 16	May 21	June 2	May 18	May 22	May 28	—	May 29	May 25	May 21
Veronica chamædrys (Germander Speedwell)	Apr. 24	Apr. 30	May 7	May 6	May 3	Mch. 29	Apr. 25	Apr. 30	May 6	May 6	Apr. 29	Apr. 26
Nepeta glechoma (Ground Ivy)	Apr. 16	Apr. 16	Apr. 16	Apr. 27	Apr. 16	Mch. 20	Apr. 10	Mch. 29	Mch. 4	—	Apr. 16	Apr. 7
Lamium purpureum (Red Dead Nettle)	Jan. 2	Mch. 5	—	—	—	Jan. 1	—	—	—	Mch. 3	Feb. 1	Feb. 4
Iris pseud'acorus (Yellow Iris)	June 7	June 8	June 16	June 10	June 18	June 6	June 5	June 4	June 14	June 16	June 10	June 8
Scilla nutans (Bluebell)	Apr. 22	May 5	May 7	May 10	May 8	Apr. 13	Apr. 24	Apr. 29	May 6	May 16	May 1	May 1
Hay cut	June 17	June 17	June 21	June 13	June 15	June 15	June 15	June 5	June 14	June 24	June 16	June 14
Wheat ear	June 19	June 22	June 13	June 13	June 24	June 21	June 16	June 17	June 17	June 23	June 18	June 17
Wheat cut	Aug. 16	Aug. 2	July 31	Aug. 1	Aug. 14	Aug. 15	Aug. 3	Aug. 2	Aug. 7	Aug. 22	Aug. 8	Aug. 8
Harvest finished	Sept. 10	Aug. 26	Sep. 8	Aug. 28	Sep. 25	Sep. 23	Aug. 29	—	Sep. 7	Sep. 21	Sep. 5	Sep. 7
Cuckoo heard	Apr. 23	Apr. 18	Apr. 18	Apr. 18	Apr. 16	Apr. 25	Apr. 24	Apr. 15	—	—	Apr. 20	Apr. 22
Nightingale heard	Apr. 29	Apr. 27	Apr. 19	Apr. 10	Apr. 16	Apr. 28	—	—	—	—	Apr. 23	Apr. 24

TABLE X.

Dates of first flowering of Garden Plants, Shrubs, etc., during the ten years 1898—1907.

Plants Flowering.	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	Averages.	
											1898-07	1888-07
Winter Aconite .	Jan. 1	Jan. 19	Jan. 8	Dec. 19	Jan. 6	Jan. 3	Dec. 22	Dec. 31	Jan. 4	Jan. 20	Jan. 4	Jan. 4
Snowdrop . .	Jan. 9	Jan. 28	Jan. 24	Jan. 15	Jan. 2	Dec. 23	Jan. 6	Jan. 22	Jan. 22	Feb. 17	Jan. 14	Jan. 17
Crocus . . .	Jan. 10	Feb. 8	Feb. 22	Feb. 25	Jan. 12	Jan. 23	Feb. 3	Feb. 8	Jan. 24	Feb. 27	Feb. 4	Feb. 5
Daffodil . . .	Mar. 3	Mar. 14	Mar. 28	Apr. 4	Mch. 20	Mch. 4	Mch. 21	Mch. 17	Mch. 7	Mch. 24	Mch. 17	Mch. 20
Ribes sanguineus .	Apr. 2	Apr. 6	Apr. 15	Apr. 22	Apr. 11	Mch. 5	Apr. 1	Mch. 17	Mch. 8	Mch. 30	Mch. 30	Mch. 27
Lilac . . .	May 13	May 19	May 13	May 20	May 22	May 13	May 14	May 14	May 10	May 7	May 15	May 12
Laburnum . .	May 15	May 18	May 19	May 24	May 27	May 8	May 12	May 14	May 15	May 12	May 16	May 15
White Pink . .	June 4	June 1	June 10	May 30	June 4	May 27	June 6	June 11	June 10	June 13	June 5	June 4
Lilium candidum .	July 14	July 9	July 5	July 6	July 13	July 6	July 6	July 3	July 5	July 20	July 9	July 8
Colchicum autumnale	Sept. 4	Aug. 26	Sept. 4	Aug. 29	Sept. 6	Aug. 21	Aug. 28	Aug. 28	Sept. 5	Sept. 11	Sept. 1	Aug. 29

IX.

BIRD-LIFE OF THE MERES.

By W. G. Clarke.

Read 23rd February, 1909.

On May 23rd, 1908, four members of this Society went by train from Norwich Thorpe to Roudham Junction, thence walked over the heathland to the meres of Wretham Heath—Ringmere, Langmere, Home Mere, Fowlmere and the Devil's Punch Bowl—and subsequently to Thetford. The botanical notes made by Messrs. W. H. Burrell and E. Peake were certainly of interest; I am privileged to exhibit to-night some of the photographic work of Messrs. Peake and G. Rye: and will confine myself to the bird-life of the meres, including also other of my notes made in the 30 visits I have paid to them during the past six years.

Strange as it may seem, Mallard are rarely met with on the meres, but on this occasion there was a pair on Ringmere, and on the north-west bank, among the bracken, a nest which had contained seven eggs: these, however, had been kicked out and were lying around. On Langmere there was also a pair which flew up, circled round and came quite close over us as though to satisfy their curiosity, a frequent habit with ducks, though apparently less so with Mallard and Tufted Duck than with others. On both meres the Mallard were the first to take alarm. A company of ducks which all seemed to be Mallard, and which was probably under-estimated at 200, rose from Langmere on August 27th, 1904. They divided into three flocks, circled round the mere once, and then splashed into the water. At our nearer approach they again arose, divided into three flocks, flew round for some

time and then went off in the direction of the park meres. Three ducks refused to rise. Two appeared to be duck Mallard and followed a pure white "Witch-duck"; wherever it led they swam after. It kept as far from us as the width of the mere would allow, but no noise sufficed to make it take flight. From end to end of the mere—as on September 4th, 1908—stretched a bed of *Polygonum amphibium* in full bloom, forming a covering of bright pink, a most beautiful sight. On November 5th, 1904, I went very cautiously up the bluff on Langmere, but directly my head appeared, all the ducks, which seemed extremely shy and were mostly Mallard, rose *en masse*, and divided into two flocks, one of about 200, and the other of 150, which after flying round once went off in the direction of Thompson Water.

Ringmere, Langmere and Fowlmere each furnished a pair of Gadwall on May 23rd, 1908. At a distance they are distinguishable by the white speculum, by riding high out of the water, and by the slender appearance of neck and head which when flying makes the wings appear as though they were set far back. Nearer at hand the median wing-coverts which are a rich chestnut serve as a ready means of identification. On the north-west bank of Ringmere, among the dead bracken fronds of the previous year, and in the open save for a sheltering clump on the north-east, was a Gadwall's nest with two rotten eggs and five or six hatched. On the south-west marge of Langmere we found a nestling not quite feathered. It did not move but squatted on the marshy soil and watched us with its beady eyes. A few minutes later when we came back, it was nowhere to be seen though the old birds had certainly not been up to it. In a letter to me in October, 1907, Mr. Heatley Noble of Henley-on-Thames, said: "I well remember the first pair of Gadwall we killed at Two-mile-bottom, and a few years later it was the commonest duck on the river. We shot sixty or more in two days. That year I killed nine different varieties of duck in two days—Scaup, Tufted, Mallard, Wigeon, Gadwall, Teal, Merganser, Pochard and Goldeneye. The last time I shot down the river I did not see nearly as many Gadwall as of old." On the meres,

however, the Gadwall still seems to be the most common duck, and during the past six years whenever I have seen ducks—and only on three visits have I not—Gadwall have been among them. On June 9th, 1907, there was a female Gadwall with a brood of eight on Ringmere while I found two dead nestlings by the edge of the water. On the higher ground to the northwest was a nest with ten eggs. It was made of fragments of dead bracken lined with down, and was well protected by the dead bracken-stalks among which it was placed. On Langmere on the same date there was a pair of Gadwall with a brood of five, and on Fowlmere a single Gadwall was followed by no less than twenty-two ducklings, probably two or three broods intermixed. There were several broods of Gadwall on the mere. At the eastern end of Langmere on March 22nd, 1908, there were many Gadwall, Tufted Duck and Coot, and eight of the first-named flew on to the long pool from the round pond, and ducks and Coot formed one big company facing the wind. On October 11th of the same year, at the end of the eastern spit of land dividing the two pools, two Gadwall were preening their feathers, erecting their wings high over their heads and smoothing the light under-parts.

Tufted Ducks have also considerably increased in numbers on the meres of late years. On our visit on May 23rd, 1908, there were two Tufted Ducks and three ducklings on Ringmere. They swam to the further side of the mere and were quickly lost to view in the rushes. A pair also rose from the pool between Ringmere and Langmere, and about fifty yards away, on the level ground near a high hawthorn hedge we disturbed a Tufted Duck—ducks will usually return after being flushed, though Pheasants oftentimes will not—from her nest of eleven eggs, packed beautifully in the down. The nest was cup-shaped, made of reeds, sedge and bracken, placed in a small isolated clump of rushes (*Juncus effusus*). On Langmere there were at least twenty Tufted Duck, all in pairs. It was a pretty sight to see them diving, or standing in pairs, about three feet apart, on the edge of the water, preening their feathers most carefully. At a distance they appear black and white, but through glasses the male is seen to be more brilliant

in plumage than the female. When floating on the water the line of white visible on each side just above the water-level is a conspicuous feature. A pair of Tufted Duck rose the same day from the Home Mere, the only ducks I have ever seen thereon. On the many other occasions I have seen Tufted Duck on these meres—I counted over eighty on Fowlmere on March 22nd, 1908—I have had many opportunities of observing their ways. From a distance the crest is not as a rule visible unless ruffled by a strong breeze, but is plainly noticeable when the neck of the bird is bent preparatory to diving.

There is one species of bird almost always to be seen on one or the other of the meres and that is the Coot, and I have seen as many as 200 at one time. On June 9th, 1907, there were three Coots and two nestlings on Ringmere, and on May 23rd, 1907, at Langmere, Mr. R. A. Cocks photographed a Coot's nest with five eggs. On June 9th, there were two Coots' nests, near one of which were two eggs floating in the water and two young Coots in the nest. These nestlings are extremely pretty creatures with orange, scarlet and purple on their heads, seeming to indicate that at an earlier stage of evolution the Coot was much more gorgeously plumaged, but has, perhaps for reasons of protection, taken on a far plainer garb. These youngsters plunged into the water and remained perfectly conspicuous among the weeds with their beaks and the top portions of their heads above the surface. There was a big flock of Duck and Coot on Langmere on March 22nd, 1908, and when my companion and I walked round the mere the Coots flew off to the round pond, but returned as quickly as possible, some flying, and some walking ungainly across the narrow strip of land. There were young Coots on Ringmere on May 9th, 1908, and on May 23 there were several nests containing eggs by the shore of the mere. The meres furnish exceptional opportunities for observation owing to the plantation close to the south shore of Ringmere, the furze, bracken, elders, hawthorns, and birches on the north; the "flighting" shelter and fir trees on the knoll by Langmere: and the firs, hawthorns and alders on the east side of Fowlmere, all giving glimpses of the mere from a hiding-place but

a few yards distant. The old Coots were, however, visible in their nests among the young reeds from end to end of Ringmere, the dark plumage and the white frontal patch being most conspicuous against the green. In this environment at this stage of the year the Coot has certainly no protective colouration. From the high ground on the north-west we were able to overlook a Coot's nest in a reed bed about twenty feet from the shore. The old bird was on the nest and four nestlings whose scarlet markings contrasted with her black plumage climbed over her body and then ran down the sides of the nest, swimming round among the reeds and then climbing into the nest again, a perfect picture of a party of irresponsible youngsters. The male bird was hiding among the reeds a few yards away. When disturbed the old birds paddled away to the centre of the mere and left the nestlings quite securely hidden among the reeds, where they kept perfectly motionless. When the parents came back again the youngsters quickly rejoined them and one of the old birds gave two of the family some water-weed it had fetched up. There was also a number of Coots' nests round Langmere, six being the largest clutch. These nests were mostly built on the dry shore of the mere, four or five feet from the edge of the water, where there was not the slightest trace of sedge or vegetation more than a couple of inches in height. The nests were chiefly made of last year's reeds obtained from the bed of the mere and incrusted with mud and lime. Several nests had bracken, the nearest of which grew 200 yards distant, but the pieces might, of course, have been blown thither. In one case there was a nest with six eggs and another with one egg, less than two yards apart. In the middle of the west end of the mere there was a big Coot's nest some thirty feet from the shore in a small clump of rushes. On the south side of the mere a tiny point of land projects into the water, and on this there is always a Coot's nest, last year proving no exception to the rule. On Langmere there were about a score Coots and the same on Fowlmere, where there were a dozen nests chiefly among the reeds in the south-east bay. Here we heard the Coot's note of defiance, at being disturbed from its nest. It

stretched its head forward, opening its beak wide, and uttering a sharp metallic chink, chink; each time a similar answer coming from another of the family at the far end of the mere.

Like Coot, Little Grebe are generally to be seen on the meres, and I have on several occasions seen twenty at one time. Nests are to be found every year, usually near the edge, but sometimes in three feet of water. On August 29th, 1905, Mr. W. A. Dutt and I watched a brood on Fowlmere. One of the old birds—presumably the male—was in charge of a single chick, and the other of three. The male would dive and bring up a piece of weed. The chick being unaware where he would come to the surface was usually paddling round gently, but even though looking in an opposite direction seemed somehow to be aware directly food was ready for it, and turning round would hurry joyfully to its parent, sometimes taking the food from its bill, and sometimes from the surface of the water where it had been placed. Occasionally the chick put its head under water, apparently watching the movements of its parent. On May 23rd, 1908, there were several nests around Ringmere, either on the edge of the water or not more than a couple of yards from the margin. Watching one nest on which we had noted the eggs were covered with weed, I saw one of the old birds return, remove the weed with its feet, although I believe it is usually done with the beak, and then sit on the eggs. There were two Little Grebe's nests on the shore of Langmere, about five feet from the edge of the water, one with the eggs covered with weed and the other with two eggs exposed. Another nest was on the bank and adjoining it was another smaller and shallower nest. The nests of Coot and Little Grebe on Langmere were, it is worthy of note, entirely unprotected by vegetation of any kind and were in some cases visible nearly half a mile distant. I have never seen a Great Crested Grebe on any of the meres, but on September 5th, 1907, in company with Mr. H. Lowerison and M. Fernand Nerson, I watched for some considerable time two pairs of Grebe on Fowlmere, and although our description of plumage, &c., written down at the time did not agree exactly with either the Sclavonian Grebe or the Eared Grebe,

it appears more probable that the birds were of the latter species. Their diving was the prettiest I have seen. They raised themselves on the surface of the water, on their feet, and then jumped up and took a real "header" just in the same spot, making hardly a ripple. They did not travel long distances under water—probably because they were not disturbed—but came up almost in the same place that they went down.

Garganey and Teal I have seen on but few occasions. There were three Garganey on Ringmere on April 2nd 1904, and four on the pond between this mere and Langmere. Both parties rose, and as we subsequently saw seven on Langmere they were probably the same birds. There were also seven on Ringmere on November 5th of the same year. The only other occasion on which I have seen Garganey was by the round pond at Langmere on April 13th, 1906, when a dozen sat in a row on the edge of the water preening their feathers, and through field-glasses appeared extremely beautiful.

The Swans that spasmodically appear on the meres are probably semi-domesticated, though it is not known whence they come. The only birds I have ever seen on the Punch Bowl were a pair of Swans on March 22nd, 1908, and a pair of Waterhens on September 4th of the same year. During the winter of 1904-5 there were twenty-one Swans on Fowlmere and fifteen on June 9th, 1908, while smaller numbers have been seen on many other occasions.

Langmere looked a fine sheet of water on April 13th, 1906, with the long basin full and two big round pools south of the bluff. By the westernmost of these, preening their feathers on the margin, were two Ruddy Sheld-duck which I examined with field-glasses before they got up. When alarmed, they came flying towards me at no great height, and went over my head, uttering harsh cries of "kraa, kraa," apparently of menace, and after circling round once settled down by the long pool. I stealthily climbed the bluff and hiding behind a pine again examined the Ruddy Sheld-duck carefully. When subsequently disturbed they once more came down the

mere towards me uttering their harsh notes. Immediately below the bluff when I first peered over, and only a few yards away, was a flock of fifteen Sheld-duck—a charming sight for a bird-lover—and I was able to examine every detail of their plumage. When I visited Langmere on April 21st, 1907, two Sheld-duck on the long pool appeared to have paired off with Gadwall, the couples swimming about together. While, however, I was watching a terrific fight ensued between one pair, the Sheld-duck being the aggressor. With desperate thrusts of its bill, it forced the Gadwall under water for a couple of minutes. When it reappeared some distance away, only its beak showed above water, and it paddled slowly to land lying down apparently exhausted on the shore. At length the Sheld-duck saw it and flew across the water, making a vicious slash at it. Then I came into the open to rescue the Gadwall, but to my surprise it got up and flew away. It had a clear start as it made for Ringmere, but the Sheld-duck went after it and by its stronger flight overtook the Gadwall and tried to attack it on the wing. It swerved, however, and went down to the mere closely pursued by its relentless antagonist. On March 22nd, 1908, with the wind blowing half a gale from the south-east there were fairly large waves on Fowlmere, and the large quantity of wildfowl included two pairs of Sheld-duck whose white neck-rings were easily distinguishable without glasses from one end of the mere to the other.

The foregoing are the species I have noted which rightfully belong to the meres, but these pools in the midst of arid heathland are frequented by many other species which come thither to wash or drink, notably the Stone Curlew and Ringed Plover.

X.

NATURAL HISTORY NOTES FROM YARMOUTH.

By Arthur H. Patterson.

Read 30th March, 1909.

1908.

In my last year's report I lamented that the year 1907 was one of the least interesting in my experience; 1908, however, proved even less productive; the summer months were exceedingly dreary; I did very little satisfactory work, and the entries in my note-book were even less interesting than in 1907.

On January 30th I tested the gastronomic qualities of a 23-lb. second year Swan which I found tender and well flavoured.

A most unusual flight of Woodcocks arrived late in January, probably birds that had come southward from Scotland, following on bad weather.

Part of the cranium of an exceedingly large Whale was washed up on the beach early in February; it weighed nearly 1 cwt., and was in all probability that of a Greater Rorqual.

Early in February the local shrimpers started business, and made large catches of "Pink" Shrimps (Æsop's Prawn). This year (1909) several of them got afloat during the middle of January, with equal success. "Pinks" in January had hitherto been unknown. They were, in both instances, large in berry, and as this species also spawns in the early autumn, the presumption is that they breed twice yearly.

February 16th. Hundreds of Hooded Crows came in from due E., and alighted on the beach, no doubt to rest on their northern journey.

On March 3rd I purchased a very beautiful 10-inch Brill (*Rhombus lævis*): the upper surface was white, save a ring of the normal colour round each eye, and ten blackish spots.

arranged as if by finger marking, around the fish at the base of the fins. The fins and tail were of the normal colour.

On March 9th between two and three thousand migratory *Corvines* came to the beach.

March 21st. Heard the first Redshank of the year, on Breydon. I spent the night there on the 29th when this species piped around in more than ordinary numbers. There were about 2000 Black-headed Gulls on the flats.

About 20 Jackdaws haunted the parish steeple in 1908, nesting there. They are very partial to the fragments of fried potatoes which are thrown upon the market by night-ramblers, and come in the early hours of the morning to glean them.

Quite a considerable number of Hake (*Merlucius vulgaris*) and Sail Flukes (*Rhombus megastoma*) appeared on the fish stalls first fortnight in April, sent up from the south-west coast.

On April 27th a mixed flock of 50 Whimbrel and Bar-tailed Godwits flew to Breydon straight from the sea, just at dusk; not finding any flats bare they wheeled round, and at length betook themselves to the marshes, the Godwits very noisily uttering their sharp quick double cry, which may be rendered as "*sweet-dick*" or "*ee-dik!*" Quite 100 Ringed Plovers on the flats early next morning; and a flock of two dozen Grey Plovers.

On May 8th I met with *Cirolarra borealis* (Lilljeborg) for the first time, a fine example being brought me by a shrimper.

On May 10th the first Swift (*Cypselus apus*) seen. The shrimpers fell in with "Pink" Shrimps so abundantly in May, that very often a single haul was more than sufficient for the day's sale. One man obtained 10 pecks in two drags. It would have been folly, they assured me, to have over-fished, for they would only have been compelled (as some were, once or twice) to throw away an overplus.

May 14th, a Codling was captured on the Fishwharf with the upper lip turned completely round and into the mouth, the lower lip protruding beyond, very much like a spoon in appearance.

On May 17th I was much interested in watching some

Whimbrel on a flat near my houseboat. They persistently hopped about upon one leg, assisting their movements occasionally by using their wings rather than drop the resting leg. Through my glasses I could distinctly see them catching small Crabs, about the size of a shilling: they shook the poor little creatures at the end of their mandibles until by the jerk or by fright they had thrown off every leg. Then laying the helpless carapace portion upon the *Zostera*, the birds would carefully gather each scattered limb, bolting the "body" in the end with evident relish.

On that particular date—a lovely Sunday morning—I also watched 150 Ringed Plovers. The males would make an occasional pretence at sparring, lowering their heads threateningly, and raising their wings. Very little movement characterised these courting antics, and a subdued ventriloquial kind of whistling sound, exactly reproduced by puckering one's mouth into a small circle and trying to *whistle* the words "*roity roity*" for some time in quick repetition. This sweet amorous piping was wonderfully fascinating, and I lay stretched on the floor of my punt for a considerable time, as if spell-bound by it and the pert manners of these delightful birds of the flat and sea-shore.

Spoonbills very scarce this summer. Saw one on May 21st: again night of 25th. On the 28th I observed a White-fronted Goose, the distinctive facial marking being very pronounced, and one black bar only across the breast.

On May 29th an adult Guillemot was washed ashore on a strong E. wind.

An Avocet seen on Breydon by a lady naturalist, week ending June 6th.

Saw a Whimbrel as late as June 7th. Despatched a very beautiful salmon-coloured Sole (*Solea vulgaris*), length 9½ inches, on June 16th, to the Norwich Museum.

July 1st. A number of young Herons on Breydon.

On July 29, when taking a trip into the roadstead on a tug we steamed to within a very short distance of ten Scoters (*Oidemia nigra*), surely a very early arrival southwards of this species!

Between two and three hundred Curlews came to Breydon second week in August. On the 15th, when strolling by the sea, I observed a Pomatorhine Skua chasing some Black-headed Gulls.

Teal turned up in more than their usual numbers in the middle of August; this would seem to have been a species greatly on the decrease in recent years.

Terns were remarkably scarce in the neighbourhood in August; so was the "Herring-syle"; and whereas in August, 1907, both were extremely abundant on Breydon, it is safe to conjecture that the visits of the one depend upon that of the other. I saw a dozen, undoubtedly Common Terns on the 25th.

September 2nd. Twice I sailed past stake No. 16 on Breydon, on top of which sat a Sandwich Tern (*Sterna cantiaca*) I could have reached it with an oar, and it only lazily flew away on my clapping my hands when within a boat's length of it. It was subsequently shot, as was a Sabine's Gull (*Xema sabinii*), which, however, I did not see.

On September 4th a double Flounder, nearly *black* on both sides, was brought me. Length 5½ inches; the "travelling" eye rested in a notch at the side of the head.

Knots, Curlews, Godwits, Redshanks, Whimbrel and small waders were very numerous on Breydon during the first week in September. Every lout who carried a gun obtained his share of Godwits, an incursion of which at this time is a rare circumstance.

Three Swifts remained here as late as September 9th; they passed over my head in the heart of the town in a half gale of wind, on this date.

September 13th. Seventy Curlews came in from due E. in the evening.

During the early part of September the belated Terns swarmed on Breydon, where a pitiless slaughter took place, and for many days the wings and bony remnants of these poor little creatures were among the flotsam at the edge of the walls, bearing witness to heartless and useless destruction, the undertaker's work being done by the vigilant wall-rats.

The September of 1908 witnessed quite an invasion of Crane-flies (*Tipula oleracea*). For two or three weeks their numbers ran into millions; they smothered the marshland, and festooned the walls of Breydon and the river: on the taller grasses on top of which they hung until they looked like over-ripe reed-tufts. As one brushed through the herbage they rose in clouds ahead, mile after mile. They were courting in the earlier part of the month, and later on the females were observed laying their eggs among the grass-roots. With a slight breeze the weakened females were blown into the water; Breydon was dotted all over with struggling and dead insects; and a black wavy line of their corpses washed up at the tide mark on the beach. During the third week in September the males, lethargic and evidently chilled, thronged the walls, and they, too, had disappeared by the last week in the month. The same super-abundance occurs at an interval of every three or four years.

September 19th. A sudden change of wind from S.W. to S.E. brought in a considerable number of Grey Plovers. I saw 40 in one bunch.

October 10th. Last night several beach boats put off with their longshore nets, and fished off Winterton. There had been a goodly inshoring of the Herrings, and the boats' home-coming provided an interesting sight that one has seldom seen in recent years. Three or four men manned a boat. They returned with their nets gleaming with beautiful fish, some with as many as 7000 for their catch. Salesmen's carts fetched them from the beach to the wharf, providing the fishermen with "trunks" to place them in. They realised from two shillings upwards, per hundred.

On October 12th a few Golden Plovers visited Breydon. This species has certainly fallen off in numbers in recent years. The stomachs of one or two I examined contained very small Winkles and *Hydrobia*.

October 16th. A clean-killed female Ring Ousel was picked up below some telegraph wires: and a goodly sized flock of Redwings came to St. George's Park, in the centre of the town.

October 18th. First Woodcock seen. A small example in

market on the 21st. There was a decided immigration on October 24th.

October 24th. Two Cormorants seen on the beach, and I picked up dead Chaffinch, Hedge Sparrow, and Redbreast at the tide-mark.

Scads (*Trachurus trachurus*) or "Horse-mackerel," were numerously taken in the herring-nets in the latter part of October.

October 28. Big influx of various *Corvines* to-day, and many Redbreasts in the neighbourhood on the 29th.

November 1st. Observed a flock of 20 Larks come straight in from the eastward, at 3.30 p.m. I should suspect these started from the Continent in the morning; this species, like several other perchers, more often arrives between daybreak and early noon; probably they would start on the afternoon previously. A Woodcock flew over my head in a busy part of the town and vanished over one of the old towers. I was amused at a couple of urchins, who took off caps and flung at it as it flew by.

November 2nd. Storm Petrel brought me alive. It was very weak, but after a little persuasion swallowed a piece of herring-milt. We had had no rough weather, and it is strange that it should have alighted on board a fishing drifter.

November 5th. The following birds were strewn along the beach between Yarmouth and Caister: 3 Rooks, 1 Crow, 4 Redwings, 1 Lark. The Crow was entire; the "Hoodies" had been feasting on the Rooks; and only one Redwing was entire. On the 7th I picked up the remains of a Hooded Crow that had been cleaned picked by its fellows.

Same date: the beach was strewn with primary and other feathers, bespeaking a moulting of Gulls. In the middle of October great numbers of primaries of the Greater Black-backed Gull were washed up with the *debris* at the tide-mark on the south beach.

Among a consignment of Norwegian Lobsters (*Neprops norwegicus*) I found several with variously distorted pincer claws. This species is more subject to variation in its legs and claws than any other crustacean I know. In ten individuals, also taken at random, the right pincer claw of four or

five may be much larger than the other, and in the remainder the left pincer claw will dominate in size.

November 5th. A family party of nine Long-tailed Tits flew townwards up from the sea, crossed the houses in the Market Place, and went inland.

Park-keeper Woods, an observant man, assured me that he had seen more Woodcocks in the park than for many years. Gold-crested Wrens were very numerously seen there swarming on the buck-thorns planted at corners of paths. A Grey Shrike alighted there on the 30th October.

A nephew of mine, who spent October on board the *Leman and Ower* Lightship, assured me that the bird-migration had been considered a better one than for some time by the men on board—*they obtained more.* Starlings were so numerous on the 17th that they filled two buckets with dead and dying, that had struck the lantern. One night the door of the lantern was left open a few minutes to cool it, when up rushed so many Starlings that they put out two of the lights. Small parties of Tree Sparrows, Gold-crests, and Chaffinches came aboard, the Gold-crests in numerous instances huddled up anywhere, and died. Two Woodcocks flew aboard and "hunched up under the windlass"; they were deftly captured, and shared the soup-pot with the commoner tramps. Gannets were numerously seen during the fishing season, and several "Molly-hawks" (Skuas). "Hawks" were observed following in the wake of the smaller birds. My nephew assures me that as one of the men lay smoking in a recumbent attitude, a "large fellow" (from its description probably a Buzzard) swooped as if to attack him, caught its wing against one of the shrouds, breaking it, and fell into the sea.

November 18. Saw a flock of quite 70 Jackdaws cross the Market Place.

A Lilac tree near St. George's Park, which had been infested with small white Caterpillars, had been most industriously freed by the Gold-crests, which dodged in and out of the branches, snapping up those that descended by their threads as well as those that crawled upon the twigs.

On November 22nd 37 Swans were reported to me as seen

on Breydon. Several [Bewicks, I believe] were observed on the Broads.

On November 21st a Spoonbill shot, an unusual visitor at this period of the year.

December 19th. I observed a pair of Grey Wagtails (*Motacilla melanope*) hunting among the tangle and refuse washed up on the timber rafts lying by the edge of Breydon. This bird haunts the neighbourhood of tidal waters more than any other of the family.

December 26th. My usual Boxing Day ramble was rewarded by a sight of many Ducks leading south along the roadstead. From Gorleston pier-head, on the bleakest day of the winter, I observed quite 60 Sheld-ducks in one flock, and 30 in another; most beautiful they looked, too, upon the wing. Hundreds of Scoters had been passing during the day. Wind E., and as keen as a razor.

Immediately following the cold snap of the 27th, Fowl became abundant on the Broads, and the Coots came to Breydon. On the 28th the Coots mustered some hundreds, and set the gunners in a ferment. These birds seem loth to return to the Broads when once they have tasted the *Zostera*; they learn very soon also to give the gunners a wide berth.

December 29th. Little Auk (*Mergus alle*) seen flying along over the breakers. Nineteen Godwits (*Limosa lapponica*) observed on the beach, and a flock of some 200 Snow Buntings alighted on the sands but did not stay there, betaking themselves almost immediately to the marshes.

Since the death of Durrant, the well-remembered game dealer, who purchased, practically, *anything*, fewer birds are seen in the market, local gunners eating their "game," or disposing of it privately; and only odd bunches of Coots, Moorhens, Ducks, Lapwings, Wood Pigeons, and a few others, are distributed among the stalls of country folk who indulge in a little desultory sport when a few birds come their way. Rare birds are immediately taken to the two or three local stuffers, and disposed of *sub rosa*. Hence many interesting birds are obtained that are never heard of outside a very narrow circle.

XI.

NOTES ON THE HERRING FISHERY OF 1908.

By T. J. Wigg.

Read 23rd February, 1909.

The 1908 Herring Season at Yarmouth has been a time of worry and anxiety for many of those who are interested in the harvest of the sea. For instance, before the commencement of the autumn fishing a proposal was made by the Port and Haven Commissioners to levy a toll of 1s. 8d. per last in addition to the 1s. 8d. per last already imposed by the Yarmouth Corporation. The boat owners find but little fault with the Corporation on account of this latter toll, as they are well aware that the Corporation spare no pains to maintain the fish wharf and find market accommodation for the fish-merchants and others who visit the port. With the Port and Haven Commissioners, however, the case is different. This body, say the boat-owners, spends the bulk of its income on dredging, making deep water quays and other work for the accommodation of vessels of heavy tonnage. Influential deputations waited upon the Commissioners, with the result that a compromise was effected and the toll was reduced from 1s. 8d. to 1s. 3d. per last. This was accepted with anything but good grace, and it is feared that the revenue from the Herring Fishery at Yarmouth will be greatly diminished next year.

The Herring Season commenced at Yarmouth and Lowestoft about the second week in October, but during that week very small catches were brought to the fishwharf. Business at sea and ashore was greatly impeded by the dense fogs which prevailed on two or three days. Small catches were the rule during the month of October; but during the first week of November some very heavy catches were brought to the

market. About 400 boats were out fishing and returned with a total of 20,600 crans. The prices per cran were from 19s. to 22s. From this time onwards the deliveries were fair average catches, except for the first week in December when the weather was very boisterous, and the dark nights told seriously against the success of the fishing. Dense fogs have also been experienced and made the navigation of the sea and river very dangerous. During this week (first in December) a large number of the sailing craft and a few steam drifters belonging to the north left for home and many of the fish-workers also took their departure by special trains to Aberdeen and other northern ports.

During the past season the unit of measurement at Yarmouth and Lowestoft has been the cran. The quarter cran measure may be a basket or a box. The basket must be of a circular form, well made and well bound. The dimensions are :—interior diameter at bottom $14\frac{1}{2}$ inches; at mouth $17\frac{1}{2}$ inches; diagonal measurement from inside the bottom to inner side of the mouth $21\frac{1}{2}$ inches; height inside $14\frac{1}{2}$ inches, rise in bottom $1\frac{1}{2}$ inches. The box must be oblong, made of well seasoned and suitable wood, and of the following dimensions :—length inside 31 inches; depth inside 7 inches; breadth inside $14\frac{3}{4}$ inches. These measures will contain 250 fair sized Herrings. Both baskets and boxes must be examined by an Inspector of Weights and Measures, verified by him, and branded or marked.

It may be interesting to note that while the enormous catches of Herrings at Yarmouth and Lowestoft are chronicled week by week in local and other papers, we are apt to lose sight of the fact that the fishing is also carried on at the same time (*i.e.*, during the Autumn) at many other places round the coast. We may mention Lerwick, Stornaway, Fleetwood, West of England (Plymouth, St. Ives, Newlyn, Newquay and Brixham). It will thus be seen that the quantity of Herrings caught round the coast of Great Britain in the course of the year is almost beyond calculation.

On comparing the figures for 1907 with those of 1908 it will be seen that at Yarmouth there was a decrease of 7576

lasts, and at Lowestoft a decrease of 3947 lasts. This was due to the fact that the Herrings left the North Sea grounds so much earlier during 1908 and so diminished the catches landed.

I quote the following note from Answers to Correspondents in the *Fish Trades' Gazette*, and although it does not really deal with the Herring Fishery on the East Coast of England, it may be of interest to Naturalists, as showing the enormous quantity of Herrings caught and delivered. "For the eight months ending 31st August, 1908, the total catch of Herrings landed in Scotland was 1,482,508 crans or 249,439 tons, and the estimated value was £1,041,570. The total weight of all kinds of fish landed in Scotland during the same period was 361,621 tons, at the estimated value of £1,963,667. You will observe that the *Herring* catch, both in weight and cash value, is far ahead of all other fish combined."

I am again indebted to Mr. W. L. Smith, the Borough Accountant of Yarmouth, and Mr. H. J. Henderson, the Harbour Master of Lowestoft, for their courtesy in furnishing me with the following figures:—

RETURNS OF HERRINGS LANDED AT YARMOUTH IN 1908.

Month.	Lasts.	Month.	Lasts.
January		Brought forward	129
February		July	52
March	—	August	511
April	18	September	2,018
May	8	October	18,233
June	103	November	21,024
		December	2,579
Carried forward	129	Total	44,546

Number of Yarmouth boats employed, about . . 240
" Scotch and other boats employed, about 600

RETURN OF HERRINGS LANDED AT LOWESTOFT IN 1908.

Month.	Lasts.	Month.	Lasts.
January		Brought forward	663
February	—	July	48
March	20	August	26
April	550	September	252
May	40	October	15,476
June	53	November	16,701
		December	2,084
Carried forward	663	Total	35,250

Number of Lowestoft boats employed, about . . 270
" Scotch and other boats employed, about 386

XII.

SOME ADDITIONS TO THE NORWICH CASTLE-MUSEUM IN 1908.

By Frank Leney,
Assistant Curator of Museum.

Read 30th March, 1909.

The additions to the collections in the Castle Museum for the year ending December 31st, 1908, included a gift from Mr. Wilfred H. Edgar of a male and female Malabar Squirrel (*Sciurus maximus*) from India, and the skeleton of the adult male Orang utan (*Simia satyrus*) from Sarawak, Borneo, presented by Dr. Chas. Hose in 1907. The ornithological collection was enriched by Captain F. R. Barton, C.M.G., Administrator of British New Guinea, with skins of Long-tailed Bird of Paradise (*Astrapia stephaniæ*) (2 specimens), Long-tailed Kingfisher (*Tanysiptera galatea*), Scarlet-breasted Kingfisher (*T. danæ*), and Stella's Parrakeet (*Charmosyna stellæ*), from New Guinea; skins of Black-throated Heron (*Ardea melanocephala*), Scissor-billed Tern (*Rhynchops flavirostris*), and Hagedash Ibis (*Hagedashia cafrensis*) from the White Nile; shot, February and March, 1907, by the donor—The Rt. Hon. Sir Savile Crossley, Bart.,; and twelve Birds' Skins from Sarawak, Borneo, viz.:—*Miglyptes tukki, Chrysocolaptes validus, Ptilopus temminckii, Palæornis longicauda, Philentoma velata, Erithacus cyaneus, Hemixus connectens, Melacopterum magnum, Macronus ptilosus, Xanthopygia cyanomelæna, Alcippe cinerea, Eurylæmus javanicus;* and Red Bird of Paradise (*Uranornis rubra*), from New Guinea; presented by Dr. Chas. Hose.

An interesting addition to the collection of British Birds is that of an immature Purple Heron (*Ardea purpurea*) taken

alive on Parade Road, Kirkley, Lowestoft, on October 9th, 1907, presented by Mr. E. V. Sterry.

Mr. E. M. Connop presented an Egg of the Demoiselle Crane (*Anthropoides virgo*) laid in confinement at Wroxham, Norfolk.

Dr. Sydney H. Long (Ex-President, N. & N. Nat. Soc.), presented two enlarged photographs of Common Tern (*Sterna fluviatilis*) taken at Wells by Mr. F. Heatherly.

Mr. Frank H. Barclay added to the geological collection a remarkably well preserved lower jaw of *Elephas meridionalis* found in the "Forest Bed" at Mundesley, and an axis vertebra of *Elephas* sp. from Overstrand.

The reception of the collection of East Anglian Prehistoric Antiquities consisting of Stone and Bronze Implements, Cinerary Urns, &c., bequeathed to the Museum by the late Mr. Edward Milligen Beloe of King's Lynn, has largely augmented our already fine series of such objects and has involved the re-arrangement of the entire collection; the choice examples also of Ancient Pottery from the Pagan and Christian Tombs in the Islands of Malta, presented by the collector, Colonel H. W. Feilden, C.B. (Vice-President N. & N. Nat. Soc.), are of great interest, and a separate case has been devoted to their display.

Four large folio volumes of illustrations of Orchids, entitled "Reichenbachia," by F. Sander, and "The Piscatorial Atlas of the North Sea, English and St. George's Channels," by O. T. Olsen, were added to the Museum reference library by the Misses Colman of Carrow House, Norwich. The Trustees of the British Museum (Nat. Hist.) presented copies of the Guides to the Collections published during 1907-8, and "List of British Seed Plants and Ferns," by A. B. Rendle. Messrs. Rowland Ward, Ltd., presented "The Sportsman's British Bird Book," by R. Lydekker, and "The Birds of Tierra del Fuego," by Captain Richard Crawshay, was purchased.

The number of visitors to the Museum was 105,415 against 111,509 recorded in 1907.

XIII.

THE ALGÆ OF SUFFOLK.

By Rev. E. N. Bloomfield, M.A.

The following lists of the Marine and Freshwater Algæ and Diatomacea were prepared for the Victoria History of Suffolk, but through want of space the localities given by the compilers were omitted. Hence it has been thought only due to them that their lists should be published in their entirety, this I am now enabled to do through the kind leave of the Directors of the Victoria History.

MARINE ALGÆ.

The coast of Suffolk is very unfavourable to the growth of Algæ, most of it being covered with sand and shingle, while there are no hard rocks. It is true a fairly long list is given in Henslow and Skepper's 'Flora of Suffolk' (H. & S.), much of it probably compiled from Dilwyn & Turner's Botanist's Guide (O. B. G.), and from the Nat. Hist. of Yarmouth (Hist. Yar.).

Suffolk species are also recorded in Greville's Algæ Britannicæ, nearly all of which were taken from the Botanists' Guide, these therefore are not quoted, but Greville's names are often given as synonyms.

The author of the following list, the late Mr. E. A. L. Batters, F.L.S., had himself collected at various places on the Suffolk coast and had received specimens from Mr. G. Massee of the Royal Herbarium, Kew. In other cases the source of information is given.

The nomenclature is that of Batter's Catalogue of The British Marine Algæ: West, Newman & Co., 1902.

Myxophyceæ.

Dermocarpa prasina, Born. on *Polysiphonia*. Felixstowe.
Hyella cæspitosa, Born. et Flah. Felixstowe.
Spirulina subsalsa, Œrsted. Felixstowe.
Oscillatoria Corallinæ, Gom. Felixstowe.
Lyngbya æstuarii, Liebm. Felixstowe.
,, semiplena, J. Ag. Gorleston.
Symploca hydnoides, Kütz. Felixstowe.
Plectonema terebrans, Born. & Flah. Felixstowe and Gorleston.
Microcoleus chthonoplastes, Thur. Felixstowe.
Calothrix confervicola, Ag. Felixstowe, Gorleston.
,, scopulorum, Ag. Felixstowe and Gorleston.
Rivularia atra, Roth. Felixstowe, Gorleston.
Mastigocoleus testarum, Lagerh. Felixstowe.
Anabæna variabilis, Kütz. Estuary of the Stour and Orwell.
,, torulosa, Lagerh. Estuary of the Stour and Orwell.

Chlorospermeæ.

Prasiola stipitata, Suhr. Gorleston.
Monostroma Grevillei, Wittr. (*Ulva lactuca*, Grev.). Felixstowe, Corton, &c.
Percursaria percursa, Rosenv. Estuary of the Yare.
Enteromorpha clathrata, J. Ag. Felixstowe, Gorleston.
,, torta, Reinb. Estuaries of the Yare.
,, compressa, Grev. Estuary of the Stour and Orwell. Felixstowe, Gorleston, &c., common.
,, Linza, J. Ag. Felixstowe. Rather rare.
,, intestinalis, Link. Common in brackish water. Estuary of the Yare. Felixstowe, &c., &c.
Ulva lactuca, L. (*latissima*, J. Ag.). Common. Felixstowe, &c.
Ulothrix flacca, Thur. Gorleston, Felixstowe, G. Massee.
Endoderma Flustræ, Batt. (*Epicladia Flustræ*, Rke.). Felixstowe.
Tellamia contorta, Batt. Felixstowe.

Urospora isogona, Batt. (*Conferva Youngana*, Dillw.). Gorleston, Felixstowe.

Chætomorpha tortuosa, Kütz. Gorleston.

,, linum, Kütz. Estuary of the Yare. Estuary of the Stour and Orwell.

,, ærea, Kütz. Felixstowe, G. Masee.

,, melagonium, Kütz. Felixstowe.

Rhizoclonium riparium, Harv. Gorleston, Felixstowe, &c. Common.

Cladophora pellucida, Kütz. Corton and Gunton, O. B. G.

,, Hutchinsiæ, Harv. Felixstowe.

,, rupestris, Kütz. Common. Felixstowe, &c.

,, hirta, Kütz. Felixstowe.

,, utriculosa, Kütz. Felixstowe.

,, glaucescens, Harv. Felixstowe.

,, fracta, Kütz. Mouth of the Yare. Salt marshes at the estuary of the Orwell and Stour.

,, arcta, Kütz. Felixstowe, G. Massee. Rare.

Gomontia polyrhiza, Born, et Flah. Gorleston.

Bryopsis plumosa, Lamour. Felixstowe, Gorleston.

Fucoideæ.

Desmarestia viridis, Lamour. Gorleston, amongst *rejectamenta*. Rare.

,, ligulata, Lamour. "Corton and Gunton, O. B. G."

,, aculeata, Lamour.

Scytosiphon lomentarius, J. Ag. Felixstowe.

Punctaria plantaginea, Grev. Felixstowe, G. Massee.

Asperococcees fistulosus, Hooker. Felixstowe.

Ectocarpus confervoides, Thur. Felixstowe.

,, siliculosus, Kütz. Felixstowe.

Pylaiella litoralis, Kjellman. Gorleston, Felixstowe.

Arthrocladia villosa, Duby. Corton and Gunton, O. B. G.

Elachistea fucicola, Fries. Felixstowe, G. Massee.

Sphacelaria cirrhosa, Ag. Felixstowe, &c., common.

Cladostephus spongiosus, Ag. Felixstowe.

,, verticillatus, Ag. Felixstowe.

STYPOCAULON SCOPARIUM, Kütz. Amongst *rejectamenta*. Gorleston.

CHORDARIA FLAGELLIFORMIS, Ag. Felixstowe, H. & S.

MESOGLOIA VERMICULATA, Le Jol. Near Yarmouth, H. & S.

LEATHESIA DIFFORMIS, Aresch. Common. Felixstowe, H. & S.

SPOROCHNUS PEDUNCULATUS, Ag. "Corton and Gunton." O. B. G.

CHORDA FILUM, Stackh. Felixstowe, H. & S.

LAMINARIA SACCHARINA, Lamour. Felixstowe Gorleston, &c. Common.

,, ,, var. PHYLLITIS, Le Jol. Yarmouth. Mr. Wigg.

,, DIGITATA, Lamour. Felixstowe, H. & S.

CUTLERIA MULTIFIDA, Grev. Yarmouth, H. & S.

FUCUS SPIRALIS, L. Felixstowe, Gorleston.

,, VESICULOSUS, L. Common. Felixstowe, &c.

,, SERRATUS, L. Common. Felixstowe, &c.

ASCOPHYLLIEM NODOSUM, Le Jol. Felixstowe, common.

PELVETIA CANALICULATA, Dene. et Thur. "Felixstowe." H. & S.

HIMANTHALIA LOREA, Lyngb. "Felixstowe." H. & S.

HALIDRYS SILIQUOSA, Lyngb. Felixstowe, common, H. & S.

CYSTOSEIRA GRANULATA, Ag. "Beach, about Yarmouth." H. & S. Very rare.

,, ERICOIDES, Ag. Yarmouth beach. Turner.

,, FIBROSA, Ag. Gorleston, amongst *rejectamenta*.

TILOPTERIS MERTENSII, Kütz. (*Ectocarpus mertensii*, Harv.). Beach, about Yarmouth, H. & S.

DICTYOTA DICHOTOMA, Lam. Corton and Gunton. O. B. G. Gorleston. Felixstowe.

TAONIA ATOMARIA, J. Ag. "Corton and Gunton." O. B. G.

FLORIDEÆ.

BANGIA FUSCOPURPUREA, Lyngb. Gorleston.

PORPHYRA UMBILICALIS, Kütz. var. LACINIATA, J. Ag. Common at Felixstowe, &c.

ACROCHÆTIUM DAVIESII, Næg. (*Callithaninion lanuginosum*, Lyngb). "On decaying Algæ, frequent," H. & S.

SCINAIA FURCELLATA, Bivona. Corton and Gunton, O. B. G.

NACCARIA WIGGHII, Endl. Near "Yarmouth," H. & S.

CHONDRUS CRISPUS, Stackh. Felixstowe, Corton, Gunton, &c. Common.

GIGARTINA STELLATA, Batt. (*G. mamillosa*, J. Ag.). Corton, Gunton, Felixstowe. Common.

PHYLLOPHORA EPIPHYLLA, Batt. (*P. rubens*, Grev.). Felixstowe.

,, MEMBRANIFOLIA, J. Ag. Felixstowe, G. Massee. Corton and Gunton.

AHNFELTIA PLICATA, Fries. Felixstowe.

CALLOPHYLLIS LACINIATA, Kütz. (*Rhodymenia laciniata*, Grev.). "Corton and Gunton, O. B. G." Alg. Br. Felixstowe. G. Massee.

CYSTOCLONIUM PURPUREUM, ǂ Batt. (*C. purpurascens*, Kütz.). Corton, Gunton, O. B. G. Gorleston, Felixstowe.

RHODOPHYLLIS BIFIDA, Kütz. (*Rhodymenia bifida*, Grev.). "On the beach Corton and Gunton," O. B. G.

GRACILARIA CONFERVOIDES, Grev. Corton and Gunton, O. B. G.

CALLIBLEPHARIS CILIATA, Kütz. (*Rhodymenia ciliata*, Grev.). Felixstowe, G. Massee. Gorleston.

RHODYMENIA PALMATA, Grev. Felixstowe, G. Massee. Gorleston.

LOMENTARIA ARTICULATA, Lyngb. (*Chylocladia articulata*, Grev.). Felixstowe, G. Massee. Rare.

,, CLAVELLOSA, Gaill. (*Chrysymenia clavellosa*, Harv.). "At Gunton and Corton, Suffolk. O. B. G."

CHYLOCLADIA OVATA, Batt. (*Gastridium ovale*, Grev.). "Coast of Suffolk." O. B. G.

PLOCAMIUM COCCINEUM, Lyngb. Felixstowe, Corton, Gunton, Gorleston.

NITOPHYLLUM RAMOSUM, Batt. (*N. laceratum*, Grev.). Corton and Gunton. O. B. G. Felixstowe. G. Massee.

,, GMELINI, Grev. Amongst *rejectamenta* Gorleston.

PHYCODRYS RUBENS, Batt. (*Delesseria sinuosa*, Lamour.). Corton and Gunton. O. B. G. Felixstowe. G. Massee.

DELESSERIA SANGUINEA, Lamour. Corton and Gunton, Mrs. Fowler. Felixstowe. G. Massee.

,, ALATA, Lamour. Felixstowe. Corton. Gunton. Gorleston. Common.

,, RUSCIFOLIA, Lamour. "Coast of Suffolk, at Corton and Gunton." O. B. G.

,, HYPOGLOSSUM, Lamour. "Corton and Gunton. O. B. G."

BONNEMAISONIA ASPARAGOIDES, Ag. At Corton and Gunton. O. B. G.

BOSTRYCHIA SCORPIOIDES, Mont. Corton and Gunton. H. & S.

RHODOMELA SUBFUSCA, Ag. "Corton and Gunton. O.B.G." Felixstowe. G. Massee.

,, LYCOPODIOIDES, Ag. Beach near Yarmouth, H. & S.

LAURENCIA PINNATIFIDA, Lamour. Felixstowe.

CHONDRIA DASYPHYLLA, Ag. (*Laurencia pennatifida*, Grev.). Beach at Corton and Gunton. O. B. G.

POLYSIPHONIA URCEOLATA, Grev. Felixstowe. Corton. &c.

,, ,, var. COMOSA. J. Ag. (*P. stricta*, Grev.). Felixstowe, &c.

,, ,, var. PATENS. J. Ag. Felixstowe, &c.

,, ELONGATA. Grev. Gorleston.

,, FASTIGIATA. Grev. Felixstowe, &c. Common.

,, NIGRA. Batt. (*P. atro-rubescens*. Grev.). Felixstowe.

,, NIGRESCENS, Grev. Felixstowe, Gorleston, Corton. &c. Common.

BRONGNIARTELLA BYSSOIDES, Bory. (*Polysiphonia byssoides*, Grev.). "Corton and Gunton," O. B. G.

HETEROSIPHONIA PLUMOSA, Batt. (*Dasya coccinea*, Ag.). Felixstowe.

SPERMOTHAMNION TURNERI, Aresch. (*Callithamnion Turneri*, Ag.). Felixstowe, G. Massee. Gorleston.

GRIFFITHSIA FLOSCULOSA, Batt. (*G. setacea*, Ag.). Very common at Felixstowe, Gorleston, &c. Corton and Gunton, O. B. G.

HALURUS EQUISETIFOLIUS, Kütz. (*Griffithsea equisetifolia*, Ag.). "Corton and Gunton." O. B. G.

RHODOCHORTON ROTHII, Næg. (*Callithamnion Rothii*, Lyngb.) Felixstowe.

CALLITHAMNION POLYSPERMUM, Ag. Felixstowe, Gorleston.

,, ROSEUM, Harv. Gorleston.

,, HOOKERI, Ag. Felixstowe.

[,, TETRICUM, Ag. "On marine rocks, common, H. & S."]

PLUMARIA ELEGANS, Schm. Felixstowe, G. Massee.

ANTITHAMNION PLUMULA, Thur. (*Callithamnion plumula*, Lyngb.). Felixstowe.

CERAMIUM RUBRUM, Ag. Felixstowe, Corton, Gunton, Gorleston, common.

,, CILIATUM, Ducluz. "Common on marine rocks," H. & S. (Probably *C. acanthonotum*, Carm., which was formerly united with *C. ciliatum*, E. A. B.).

HALARACHNION LIGULATUM, Kütz. (*Halymenia ligulata*, Ag.). Corton and Gunton, O. B. G.

FURCELLARIA FASTIGIATA, Lamour. Felixstowe, Gorleston.

POLYIDES ROTUNDUS, Grev. Coast of Suffolk, O. B. G.

CORALLINA OFFICINALIS, Ellis and Solan. Felixstowe.

EXCLUDED SPECIES.

SARGASSUM VULGARE, Ag. This species is not a native of the British seas, but merely a waif.

FRESHWATER ALGÆ AND DIATOMACEÆ.

The Suffolk list of Diatomaceæ, including the Freshwater and Marine species, is almost entirely due to the late Mr. E. Skepper, as is given in Henslow and Skepper's Suffolk Flora, 1860, but Professor G. S. West, F.L.S., has herein revised the list and employed modern nomenclature.

Comparatively few species of Desmids and Freshwater Algæ have been recorded for the county, and these principally by Messrs. Henslow and Skepper in their Flora, who were doubtless indebted to Dilwyn and Turner's Botanist's Guide, the Sketch of the Natural History of Yarmouth, and a few other sources.

A small collection was, however, made in May, 1896, by the late Mr. W. West, B.A., when botanizing on Cavenham Heath, who met with about twenty species, most of which are here recorded.

For the very interesting remarks by Professor West on collecting and preserving Desmids, &c., and on the distribution &c., of the species, I would refer to the Victoria History of Suffolk.

The following is a list of most of the species known to occur, a few of the diatoms are those of brackish water.

Diatomaceæ.

Melosira Borreri, Grev. Common.
,, varians, Ag. Frequent.
Cyclotella Kutzingiana, Chauvin. Frequent.
,, Astræa, Kutz. Frequent.
Cylindrotheca gracilis, Grun. Bury, Felixstowe Ipswich, &c.
Tabellaria flocculosa, Kütz. Bury, &c.
,, fenestrata, Kütz. Bury, &c.
Meridion circulare, Ag. Frequent.
Diatoma vulgare, Bory. Common.
,, elongatum, Bory. Bury.

DIATOMA EHRENBERGII, Kütz. *forma grandis*, W. Sm. Bury.
FRAGILARIA CAPUCINA, Desm. Common.
,, MUTABILIS, Grün. Common.
,, CONSTRUENS, Grün, var. BINODIS, Grün. Walton.
SYNEDRA ULNA, Ehr. Common.
,, RADIANS, W. Sm. Common.
,, PULCHELLA, Kütz. Common.
EUNOTIA LUNARIS, Grün. Common.
ACHNANTHES LINEARIS, W. Sm. Walton.
COCCONEIS PEDICULUS, Ehr. Common.
,, PLACENTULA, Ehr. Common.
NAVICULA SERIANS, Kütz. Near Ipswich.
,, CUSPIDATA, Kütz. Common.
,, IRIDIS Ehr., var. FIRMA, W. Sm. Bury, Ipswich, &c.
,, var. PRODUCTA, W. Sm. Bury, &c.
,, ELLIPTICA, W. Sm. Frequent.
,, ELEGANS, W. Sm. Ipswich, Walton, &c.
,, LIMOSA, Kütz., var. GIBBERULA, Van Heurck. Bury, &c.
,, AMBIGUA, Ehren. Bury, &c.
,, AMPHISBŒNA, Bory. Common.
,, TUMENS, W. Sm. Common.
,, BINODIS, W. Sm. Bury, &c.
,, PYGMÆA, Kütz. Walton, Ipswich, &c.
,, MAJOR, Kütz. Common.
,, NOBILIS, Kütz. Cavenham Heath.
,, VIRIDIS, Kütz. Common.
,, OBLONGA, Kütz. Common.
,, PEREGRINA, Kütz. Common.
,, TABELLARIA, Kütz., var. ACROSPHÆRIA, Raben. Cavenham Heath.
,, RADIOSA, Kütz. Common.
,, ACUTA, Van Heurck. Bury.
,, GRACILIS, Kütz. Bury, &c.
,, VIRIDULA, Kütz. Bury, &c.

NAVICULA DIGITATO-RADIATA, Greg., var. CYPRINUS. Van Heurck. Common.
,, DIVERGENS, Ralfs. Bury. &c.
,, BREBISSONII, Kütz. Common.
,, JOHNSONII, W. Sm. Ipswich.
,, MESOLEPTA, Ehren. Common.
,, RABENHORSTII, Grün. Common.
,, CRUCICULA, Van Heurck. Frequent.
VANHEWICKIA RHOMBOIDES, Breb. Near Ipswich.
STAURONEIS PHŒNICENTERON, Ehren. Common.
,, ANCEPS, Ehren. Bury, &c.
,, ,, var. LINEARIS, Van. Heurck. Bury, &c.
PLEUROSIGMA ACUMINATUM, Grun. Bury. Ipswich, &c.
,, ATTENUATUM, W. Sm.
,, SPENCERII. W. Sm. Bury, Boynton, &c.
GOMPHONEMA AUGUR. Ehren. Bury. &c.
,, CONSTRICTUM, Ehren. Frequent.
,, ACUMINATUM. Ehren. Frequent.
,, OLIVACEUM, Ehren. Common.
RHOICOSPHENIA CURVATA, Grün. Common.
ENCYONEMA PROSTRATUM, Ralfs. Bury.
,, CÆSPITOSUM. Kütz, Felixstowe.
CYMBELLA AFFINIS, Kütz. Frequent.
,, CUSPIDATUM. Kütz. Frequent.
,, EHRENBERGII. Kütz. Frequent.
COCCONEMA LANCEOLATUM, Ehren. Common.
,, CYMBIFORME. Ehren. Frequent.
,, CISTULA. Ehren. Frequent.
AMPHORA SALINA. W. Sm. Ipswich. Walton Ferry. &c.
,, HYALINA. Kütz. Ipswich. Walton Ferry. &c.
,, OVALIS. Kütz. Common.
,, ,, var. AFFINIS. Kütz. Ipswich. Walton
,, Ferry. &c.
,, ,, var. PEDICULUS. Kütz. Bury.
EPITHEMIA TURGIDA. W. Sm. Frequent.
,, SOREX. Kütz. Frequent.
,, ZEBRA. Kütz. Frequent.
,, GIBBA. Kütz. Frequent.

EPITHEMIA VENTRICOSA, Kütz. Frequent.
BACILLARIA PARADOXA, Gmel. Common.
NITZSCHIA SIGMOIDEA, W. Sm. Common.
,, LINEARIS, W. Sm. Common.
,, SIGMA, W. Sm. Frequent.
,, SPECTABILIS, Ralfs. Near Ipswich.
,, AMPHIOXYS, W. Sm. Common.
,, VIVAX, W. Sm. Bury.
,, BILOBATA, W. Sm. Ipswich.
,, PLANA, W. Sm. Common.
,, ACICULARIS, Sm. Bury, &c.
,, GRACILIS, Raben. Frequent, Bury, Felixstowe, Ipswich, &c.
,, LANCEOLATA, W. Sm. Walton Ferry.
,, CONSTRICTA, Pritch. Ipswich, frequent.
CYMATOPLEURA SOLEA, W. Sm. Frequent.
,, ,, var. APICULATA, Pritch. Frequent.
,, ELLIPTICA, W. Sm. Frequent.
SURIRELLA BISERIATA, Bréb. Bury, Ipswich, &c.
,, LINEARIS, W. Sm. Bury.
,, GRACILIS, Grün. Bury, Walton, Ipswich, &c.
,, STRIATULA, Turp. Frequent.
,, BRIGHTWELLI, W. Sm. Frequent.
,, MINUTA, Bréb. Common.
,, OVATA, Kütz. Common.
,, ,, var. SALINA, W. Sm. Common.
CAMPYLODISCUS NORICUS, Ehren., var. COSTATUS, W. Sm. Mermaid's Pits, Bury.
,, ECHENEIS. Ehren. Woodbridge.

The following are Marine Diatoms :—

PODOSIRA HORMOIDES, Kütz. Ipswich.
,, MACULATA, Sm. Ipswich.
MELOSIRA NUMMULOIDES, Ag. Ipswich.
,, SULCATA, Kütz. Ipswich, &c. Common.
HYALODISCUS STELLIGER, Bail. Ipswich, &c. Abundant.
COSCINODISCUS EXCENTRICUS, Ehr. Ipswich, Walton, &c.
,, RADIATUS, Ehr. Ipswich, Walton, &c.

Coscinodiscus radiatus, var. concinnus, W. Sm. Ipswich.
Actinoptychus undulatus, Ehr. Ipswich, frequent.
Auliscus sculptus, Ralfs. Ipswich.
Eupodiscus Argus, Ehr. Ipswich.
Actinocyclus crassus, Van Heurck. Ipswich.
Biddulphia aurita, Bréb. Ipswich.
,, pulchella, Gray. Ipswich and Walton.
,, rhombus, W. Sm. Ipswich.
,, Smithii, Van Heurck. Ipswich.
,, pavus, Van Heurck. Ipswich.
Synedra affinis, Kütz. Walton.
,, fulgens, W. Sm. Ipswich.
,, superba, Kütz. Ipswich.
Achnanthes longipes, Ag. Common.
,, brevipes, Ag. Common.
Schizonema eximium, Thur. Walton and Ipswich.
,, crucigerum, Lowestoft and Ipswich.
,, Grevillii, Ag. Common.
Cocconeis scutellum, Ehr. Common.
,, diaphana, W. Sm. Common.
Navicula Smithii, Ag. Ipswich. rare.
,, didyma, Ehren. Common.
,, marina, Ralfs. Common.
,, Hennedyi, W. Sm., var clavata, Van Heurck. Ipswich.
,, lyra, Ehren. Walton.
,, directa, W. Sm. Lake Lothing. Ipswich.
,, aspera, Ehren. Ipswich.
Scoliopleura Westii, Grün. Ipswich. Walton. &c.
,, latestriata, Grün. Ipswich. Walton. &c.
,, tumida, Rabenh. Ipswich. Walton. &c.
Stauroneis salina, W. Sm. Ipswich.
Pleurosigma formosum, W. Sm. Walton. Ipswich. &c.
,, decorum, W. Sm. Walton. Felixstowe. Ipswich.
,, speciosum, W. Sm. Walton.
,, rigidum, W. Sm. Ipswich.
,, elongatum, W. Sm. Frequent.
,, strigosum, W. Sm. Frequent.

Pleurosigma quadratum, W. Sm. Walton, Ipswich, &c. Common.
,, angulatum, W. Sm. Walton, Ipswich, &c. Common.
,, Æstuarii, W. Sm. Walton, Ipswich, &c. Common.
,, Balticum, W. Sm. Walton, Ipswich, &c. Common.
,, fasciola, W. Sm. Walton, Ipswich, &c. Common.
,, intermedium, W. Sm. Walton, Ipswich, &c. Common.
,, acuminatum, W. Sm. Felixstowe.
,, prælongum, W. Sm. Lake Lothing.
,, tenuissimum. W. Sm. Walton.
,, littorale, W. Sm. Ipswich, Orford.
,, Hippocampus, W. Sm. Common.
Doryphora amphiceros, Kütz. Common.
Amphiprora alata, Kütz. Common.
,, constricta, Ehren. Walton and Ipswich.
,, vitrea, W. Sm. Walton and Ipswich.
,, elegans, W. Sm. Walton, &c.
Mastogloia Smithii, Thw. Ipswich.
Rhoicosphenia curvata, Grün., var, marina, W. Sm.
Epithemia musculus, Kütz., var. constricta, W. Sm. Near Manningtree.
Tryblionella acuminata, W. Sm. Ipswich, &c.
,, marginata —— ? Ipswich, &c.
Nitzschia angularis, W. Sm. Ipswich.
,, longissima, Ralfs. Felixstowe, Walton Ferry.
,, longissima, Ralfs. var.
,, Closterium, W. Sm. Felixstowe, Ipswich, &c.
Surirella Gemma, Ehren. Common.
Campylodiscus Hodgsonii, W. Sm. Near Ipswich.
,, parvulus, W. Sm. Felixstowe and Ipswich.
Podosphenia Ehrenbergii, Kütz. Ipswich, &c.
Rhipidophora elongata, Kütz. Ipswich, &c.
,, paradoxa, Kütz. Ipswich, &c.

AMPHITETRAS ANTEDILUVIANA, Ehr. Ipswich.
GRAMMATOPHORA MARINA, Kütz. Ipswich.
RHABDONEMA ARCUATUM, Kütz. Ipswich
,, MINUTUM, Kütz. Felixstowe.

Among the few other fresh-water Algæ known to occur are the following :—

RHODOPHYCEÆ.

LEMANEA TORULOSA, Ag. Near Breydon Broad. Hist. Yarm.
BATRACHOSPERNUM MONILIFORME, Ag. Common.
,, VAGUM, Ag. Ipswich.

CHLOROPHYCEÆ.

BULBOCHÆTE SETIGERA, Ag. Frequent.
ŒDOGONIUM VESICATUM, Witta. Frequent.
CHÆTOPHORA CORNU-DAMÆ, Ag. Frequent.
,, TUBERCULOSA, Ag. Santon Downham.
ULOTHRIX ZONATA, Kütz. Lound. Hist. Yar.
,, RIVULARIS, Kütz. Common.
,, PARIETINA, Kütz. Common.
MYXONEMA TENUE, Rabenh. Browston, Thetford, &c.
DRAPARNALDIA GLOMERATA, Ag. (*C. mutabilis*). Bradwell. &c. O. B. G.
TRENTEPOHLIA AUREA, Mart. Common.
ENTEROMORPHA INTESTINALIS, Link. Crillon Broad. &c.
PRASIOLA CRISPA, Menegh. Bury.
,, FURFURACEA, Menegh. Near Framlingham Church
CHÆTOMORPA LINUM, Kütz. Breydon.
CLADOPHORA FRACTA, Kütz. Frequent.
,, GLOMERATA, Kütz. Frequent.
VAUCHERIA SESSILIS, Ob., var CÆSPITOSA, Raben. Common.
,, DICHOTOMA, Ag. Common.
,, GEMINATA, Dc. Common.
,, ORNITHOCEPHALA, Hass. Common.
,, TERRESTRIS, Lyngb. Common.
,, DILLWYNII, Ag. Common.

Mougeotia genuflexa, Ag. Near Yarmouth, O. B. G.
Spirogyra nitida, Link. Near Yarmouth, H. & S.
,, decimina, Kütz. Common.
,, quinina, Kütz. Common.
,, pellucida Kütz. Corton and Gunton. H. & S.
Zygnema pectinatum, Ag. (*bipunctata*). Bradwell. O. B. G.
,, cruciatum, Ag. Common.
,, ericetorum, Hansg. Lound, Bradwell, &c. O. B. G.
Pleurotænium truncatum, Nag. Cavenham Heath.
Closterium Dianæ, Ehr. Cavenham Heath.
,, striolatum, Ehr. Cavenham Heath.
,, Kutzingii, Bréb. Cavenham Heath.
,, Lunula, Nitgsch. Common.
Cosmarium Botrytis, Menegh. Cavenham Heath.
Hyalotheca dissiliens, Bréb. Cavenham Heath, Wesleton
Volvox globator, Ehren. Bury and Ipswich.
Pleurococcus vulgaris, Meneg. Common.
Hydrodictyon utriculatum, Roth. Bungay, &c.
Scenedesumus quadricauda, Bréb. Bury and Ipswich.
Pediastrum Boryanum, Meneg. Bury.
Palmella botryoides, Kütz. Frequent.
Glœocystis gigas, Lager. Cavenham Heath.
Hydrianum heteromorphum, Reinsch. Cavenham Heath.
Tetraspora lubrica, Roth. Bradwell, Belton, O. B. G. Corton, Gunton, H. & S.
Ophiocytium cochleare, A. Br. Frequent.
Tribonema bombycina, Derb. & Sol. Cavenham Heath, Hopton.

Myxophyceæ.

Porphyridium cruentum, Näg. Common.
Tolypothrix distorta, Kütz. Lound, Thetford.
Anabæna flos-aquæ. Cavenham Heath. &c.
Lyngbya ochracea, Thur. Common.
Phormidium autumnale, Gomont. Common.

OSCILLATORIA TENUIS, Ag. Common.
,, NIGRA, Vauch. Common.
,, LIMOSA, Ag. Common.
NOSTOC SPHÆRICUM, Vauch. (*U. pisiformis*). Bradwell. O. B. G.
,, CŒRULEUM Lyngb. Ixworth. Thorpe.
,, COMMUNE, Vauch. Common.
,, PRUNIFORME, Ag. Belton. Common, near Yarmouth, O. B. G.
,, MICROSCOPICUM, Carm. Cavenham Heath.
GLOIOTRICHIA NATANS, Ag. Belton Common.

XIV.

FAUNA AND FLORA OF NORFOLK.

THE NON-MARINE MOLLUSCA OF NORFOLK.

BY A. MAYFIELD.

Read 26th February, 1909.

SEVERAL years have now elapsed since the last list of Norfolk non-marine Mollusca was published, during which time much advance has been made in our knowledge of British Conchology: new species have been discovered, many that were once considered rare have proved on close research to be fairly common, and improvements have been made in the nomenclature.

With a view to bringing the record of this branch of our local natural history up to date, I have compiled the present list, which contains notice of several species not hitherto recorded for the county, and many additional localities for the more uncommon kinds whose presence has already been recognised. For the sake of completeness I have included past records from every available source.

Comparing Norfolk with the neighbouring county of Suffolk, it is noticeable that the Rivers Yare and Bure yield a much greater abundance of molluscs than do the Gipping, Deben and Alde, especially of the larger bivalves. The broads also contain immense quantities of the commoner kinds. But the upper reaches of the rivers, and the ponds of the upland districts, although not so abundantly teeming with life, produce a greater variety of species.

Of Land Snails the uplands are inhabited by the larger kinds:—Helix, Helicella, etc., while the smaller species seem to prefer a moister situation in the river-valleys.

The fens in the valley of the Little Ouse and Waveney, are particularly rich in molluscan life. At Roydon Fen, near Diss, I have taken from a couple of handfuls of flood rejectamenta, more than thirty species of land and freshwater shells, including two of the rarest British species, viz., *Vertigo moulinsiana* and *V. angustior*. It is also remarkable that all the English species belonging to the genus *Vertigo* except *alpestris*, a northern form, occur in this valley.

The arrangement and nomenclature are in accordance with the 'List of British Non-Marine Mollusca.' prepared by Mr. B. B. Woodward, F.L.S., and published by the Conchological Society of Great Britain and Ireland.

The brackets placed around the name of an authority signify that the species has been removed from the Genus in which the author originally placed it.

Of the 144 living species considered as indigenous to the British Isles, 111 are here recorded as found in Norfolk. Most of the others are apparently confined to counties remote from East Anglia, so that the list may be considered almost, if not quite, complete.

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1893. "The Land and Freshwater Mollusca of East Norfolk." Rev. S. Spencer Pearce, M.A., and A. Mayfield. (Journal of Conchology, vol. vii., pp. 391-404.).

[Localities given on the authority of the Rev. S. Spencer Pearce are initialled "S.S.P."]

1895. "The Land and Freshwater Mollusca of West Norfolk." T. Petch, B.A. (Trans. Norf. and Norw. Nat. Soc., vol. vi., pp. 61-67.).

[Records from this source are marked "T.P."]

1896. "The Mollusca of Norfolk." A. Mayfield. (Trans. Norf. and Norw. Nat. Soc., vol. vi. pp. 185-189.).

1902—7. "Monograph of the Land and Freshwater Mollusca of the British Isles." J. W. Taylor. Several records relating to the Slugs are quoted from vol. ii.

E. = East. W. = West.

TESTACELLA HALIOTIDEA, Draparnaud.

E. Aylsham, Yelverton (S.S.P.). Garden, Ipswich Road (Bridgman).

W. Didlington Hall (A. Tanner. Webb in Journal of Malacology, July 1897, p. 28).

T. SCUTULUM, Sowerby.

E. Mackie's Nursery, Norwich (J. Reeve). Foulsham (Rev. J. W. Horsley).

W. King's Lynn (Miss Peckover).

LIMAX MAXIMUS, Linné.

E. Yelverton, Howe, Whitlingham (S.S.P.). Kirby Bedon, Heigham, Norwich (A.M.). Strumpshaw Hall (W. J. O. Holmes). Long Stratton (L. E. Adams), Starston (Rev. W. Whitear).

W. Common (T.P.), King's Lynn (C. B. Plowright).

.. var. FASCIATA, Raz.

E. Holt (T.P.).

W. King's Lynn (C. B. Plowright).

.. var. CELIARIA, d'Argenville.

E. Strumpshaw Hall (W. J. O. Holmes).

W. King's Lynn (C. B. Plowright).

LIMAX MAXIMUS, var. FERUSSACI, Moq-Tand.
E. Starston (British Museum, Cockerell).
,, var. SYLVATICA, Morelet, and sub. var. SERPENTINA.
E. Strumpshaw Hall (W. J. O. Holmes).
LIMAX FLAVUS, Linné. In cellars and outhouses.
E. Yelverton, Framingham Earl (S.S.P.), Norwich (A.M.), Strumpshaw Hall (W. J. O. Holmes).
W. Common (T.P.), King's Lynn (C. B. Plowright).
,, var. FLAVESCENS, Fér.
E. Strumpshaw Hall (W. J. O. Holmes).
,, var. RUFESCENS, Moq. Tand.
E. Strumpshaw Hall (W. J. O. Holmes).
L. ARBORUM, Bouchard-Chantereax [=*marginatus*, Müll].
E. On beeches, Whitlingham Woods (S.S.P.), On Willows, Eaton (A.M.). On a wall near the Station, Holt (T.P.).
W. King's Lynn (C. B. Plowright).
,, var. DECIPIENS, Ckll.
E. Near Norwich (Brit. Mus., Cockerell).
,, var. PALLENS, Less. & Poll.
E. Near Norwich (Brit. Mus. Cockerell).
,, var. BETTONII, Sordelli.
E. Near Norwich (Brit. Mus., Cockerell).
,, var. NEMOROSA, Baudon.
W. King's Lynn (C. B. Plowright).
AGRIOLIMAX AGRESTIS (Linné). Common everywhere.
,, var. BRUNNEA, Taylor.
E. Norwich (A.M.).
W. Garden, King's Lynn (C. B. Plowright).
A. LÆVIS (Müller). In marshes and damp places.
E. Bramerton, Surlingham Ferry, Whitlingham (S.S.P.), Costessey, Colney, Postwick, Roydon Fen, (A.M.), Diss, Cringleford (L. E. Adams).
W. Wormegay, St. Germans (T.P.), Thetford (L. E. Adams).
MILAX SOWERBYI (Férussac) [=*Amalia marginata*]. Generally found on old flint walls.

E. Kirby-Bedon. Catton (A.M.). Thorpe (J. B. Bridgman).

W. Amongst nettles near beach. Hunstanton (T.P.) King's Lynn (C. B. Plowright).

M. GAGATES (Draparnaud). Rare.

E. In gardens, Heigham, Norwich (A.M.).

W. King's Lynn (C. B. Plowright).

VITRINA PELLUCIDA (Müller). Under dead leaves in damp places.

E. Yelverton Churchyard, Whitlingham Woods (S.S.P.). Heigham, Earlham, Mousehold Heath, Stratton Strawless, Roydon (A.M.).

W. Castle Rising, Hunstanton, Ringstead, Terrington, Middleton (T.P.), Blo Norton, Garboldisham Weeting (A.M.).

VITREA CRYSTALLINA (Müller). Under dead leaves in damp places.

E. Whitlingham Woods (S.S.P.). Costessey, Heigham, Earlham, Roydon Fen (A.M.). Holt (T.P.).

W. Hunstanton, Ringstead, Castle Rising, Middleton (T.P.). Blo Norton, Weeting (A.M.).

,, var. CONTRACTA, Westerlund.

E. Whitlingham Woods (S.S.P.). Costessey (A.M.).

V. CELLARIA (Müller). Common in damp places and among garden rubbish.

E. Whitlingham, Yelverton, Rockland St. Mary, Framingham Earl (S.S.P.). Heigham, Earlham, Lakenham, Norwich Cemetery (A.M.).

W. Gayton, Castle Rising, Reffley, North Wootton (T.P.). Blo Norton, Garboldisham, Thetford (A.M.).

V. ROGERSI, B. B. Woodward. Not uncommon among dead leaves, but often mistaken for *V. alliaria*. Like that species it sometimes has a garlic-like smell.

E. Costessey, Earlham, Caistor St. Edmunds, Diss (A.M.).

W. Blo Norton (A.M.).

V. ALLIARIA (Miller). Among moss and dead leaves. Not common.

E. Whitlingham (S.S.P.).

W. Gayton Road, Castle Rising, Hardwick, Middleton, North Wootton, Hunstanton (T.P.).

V. NITIDULA (Draparnaud). Common in grass, moss and dead leaves.

E. Rockland St. Mary, Yelverton, Whitlingham (S.S.P.), Heigham, Earlham, Thorpe, Lakenham, Roydon (A.M.), Holt (T.P.).

W. Castle Rising, Middleton, Wormegay, St. Germans, Terrington, Reffley, Brancaster (T.P.) Blo Norton, Weeting (A.M.).

,, var. HELMII, Alder.

E. Old Lakenham (A.M.).

V. PURA (Alder). In moss and dead leaves. Rare.

E. Caistor St. Edmunds, Dunston (A.M.).

,, var. MARGARITACEA, Jeff.

E. Dunston (A.M.).

V. RADIATULA (Alder). In moss. Not common.

E. Whitlingham Woods, Surlingham Ferry (S.S.P.) Costessey, Roydon Fen (A.M.).

W. Garboldisham (A.M.), Ringstead, Narborough, North Wootton (C. B. Plowright).

ZONITOIDES NITIDUS (Müller). Generally found crawling on the mud by the sides of rivers and ditches.

E. Whitlingham Marsh, Bramerton, Surlingham Ferry, Stoke Holy Cross (S.S.P.). Colney, Costessey Common, Roydon Fen (A.M.), Cringleford (L. E. Adams).

W. St. Germans, Wormegay, Hunstanton (T.P.), Weeting (A.M.).

EUCONULUS FULVUS (Müller). In similar situations to the preceding.

E. Surlingham Ferry, Whitlingham (S.S.P.), Earlham, Costessey Common, Eaton, Roydon Fen (A.M.), The Grove, Bracondale, Norwich (Lindley H. Jones).

W. North Wootton, St. Germans, Bawsey, Castle Rising, Middleton (T.P.), Blo Norton (A.M.).

ARION ATER (Linné). The black form is well distributed throughout the county.

,, var. CASTANEA, Dum. and Mort.

E. Alpington, Yelverton, Rockland (S.S.P.) Strumpshaw Hall (W. J. O. Holmes), Heigham Marshes (W. K. Bridgman), St. Faith's (A.M.).

W. Middleton, Gaywood, Wormegay, Setch (T.P.).

, var. RUFA, Linné.

E. Strumpshaw Hall (W. J. O. Holmes), Postwick Grove (A.M.).

W. Middleton, King's Lynn (T.P.).

A. INTERMEDIUS, Normand [= *A. minimus*, Simroth]. Among grass and dead leaves in damp places.

E. Caistor St. Edmund's, Dunston, Buckenham (A.M.), near Norwich (E. J. Lowe).

W. St. Germans (T.P.), Didlington Hall (Hon. Mrs. Evelyn Cecil).

, var. PLUMBEA, Collinge.

W. With type at Didlington Hall.

A. HORTENSIS, Férussac. In gardens and fields.

E. Whitlingham, Yelverton, Framingham Earl (S.S.P.), Heigham, Earlham, St. Faith's (A.M.), Long Stratton, Diss (L. E. Adams), Strumpshaw Hall (W. J. O. Holmes).

W. Thetford (L. E. Adams), King's Lynn (C. B. Plowright), Didlington Hall (Hon. Mrs. Evelyn Cecil).

,, var. GRISEA, Moq-Tand.

E. Heigham (A.M.).

A. FASCIATUS, Nilsson [=*A. bourguignati*]. Among grass and dead leaves.

E. Norwich (L. E. Adams), Roydon (A.M.).

W. St. German's (T.P.), King's Lynn, Gayton (C. B. Plowright), Didlington Hall (Hon. Mrs. Evelyn Cecil), Thetford, Blo Norton (A.M.).

PUNCTUM PYGMÆUM (Drap). [=*Helix pygmæa*]. Among dead leaves in woods and ditches.

E. Framingham Pigott, Yelverton (S.S.P.), Heigham, Earlham, Hellesdon, Costessey, Roydon Fen, Flordon Common* (A.M.), The Grove, Bracondale, Norwich (Lindley H. Jones),

W. Gayton Road, North Wootton, Middleton, Wolferton (T.P.), Garboldisham, Blo Norton (A.M.).

SPHYRADIUM EDENTULUM (Drap). [=*Vertigo edentula.*] Among dead leaves in woods, etc.

E. Costessey, Earlham (A.M.), Thorpe, near Mangreen Hall (Bridgman).

W. Gayton Road Station (T.P.), Blo Norton (A.M.).

PYRAMIDULA ROTUNDATA (Müller). [=*Helix rotundata*]. Under stones and leaves in gardens and woods.

E. Yelverton, Whitlingham, Rockland St. Mary (S.S.P.), Thorpe, Postwick, Carrow, Costessey (A.M.), Kirby Bedon (Lindley H. Jones).

W. Gayton Road, Castle Rising (T.P.).

HELICELLA VIRGATA (Da Costa). [=*Helix virgata*]. On hedgebanks on sandy soil. Abundant on grassy slopes near the sea.

E. Between Old Lakenham and Bracondale, Yelverton (S.S.P.), Heigham, Hellesdon, Drayton, Cromer, Overstrand, Mundesley (A.M.), Brundall (Bridgman).

* This, and all other species recorded for Flordon Common, were obtained from material sent me by Mr. W. G. Clarke.

W. Brancaster, Holme, Hunstanton, North Wootton, West Winch, Setch, Lynn (T.P.), Swaffham (Bridgman), Wells, Weeting (A.M.), Castle Hill, Thetford (W. G. Clarke).

,, var. SUBALBIDA, Poiret.

E. Earlham Road, Norwich (A.M.), near Old Lakenham (S.S.P.).

,, var. ALBICANS, Grat.

E. Earlham Road, Norwich, Hellesdon (A.M.), near Old Lakenham (S.S.P.).

,, var. LINEATA, Olivi. [= var. *submaritima*, Jeff].

E. Yelverton (S.S.P.), Thorpe, Postwick, Hellesdon, Mundesley, Cromer, Overstrand (A.M.),

W. Hunstanton (T.P.).

,, var. HYALOZONA, Taylor.

W. Common on the sand hills, Hunstanton. On the Ringstead Road (T.P.).

,, var. CARINATA, Jeff.

E. Thorpe (A.M.).

H. ITALA (Linné). [=*H. cricetorum*]. Very common on hedgebanks in dry places.

,, var. GRISESCENS, Colbeau.

E. Bramerton, Bixley, Framingham, Yelverton (S.S.P.). Thorpe, Earlham, Bowthorpe, Hellesdon (A.M.).

W. Hunstanton (T.P.).

,, var. MINOR, Moq-Tand.

E. Heigham (S.S.P.), Bowthorpe, Earlham (A.M.).

,, var. HYALOZONATA, Cockerell.

W. Hunstanton (T.P.).

,, var. ALBA, Charpentier.

W. Hunstanton (T.P.).

H. CAPERATA (Mont.). On dry hedgebanks, pastures and fields. Generally distributed throughout the county.

H. CAPERATA, var. MAJOR. Jeff.

E. Stoke Holy Cross (S.S.P.), Eaton, Framingham Earl (A.M.).

,, var. GIGAXII, Charp.

E. Thorpe, Eaton (A.M.).

,, var. ORNATA, Picard.

E. Stoke Holy Cross, (S.S.P.).

W. Hunstanton (T.P.), Thetford (A.M.).

,, var. BIZONALIS, Moq. Tand.

E. Yelverton (S.S.P.).

,, var. LUTESCENS, Pasc.

E. Yelverton (S.S.P.), Eaton, Thorpe, Hellesdon, Framingham Earl (A.M.).

,, var. OBLITERATA, Picard.

E. Yelverton (S.S.P.), Hellesdon and Drayton (A.M.).

,, var. ALBA, Picard.

E. Drayton, Hellesdon (A.M.).

W. Thetford (A.M.).

H. CANTIANA (Montagu). On hedgebanks, among nettles. More common in the southern than in the northern part of the county.

E. Hedenham, near Bungay, Yelverton, Alpington, Burgh Apton Bramerton, Poringland, Framingham Earl and Pigott, Reedham, Bixley, Stoke Holy Cross (S.S.P.), Eaton, Old Lakenham, Thorpe (A.M.), Whitlingham Lane, Norwich (Bridgman).

W. Fairly common at Lynn, and Middleton (T.P.).

,, var. ALBIDA, Taylor.

W. South Lynn (T.P.).

H. CARTUSIANA (Müller).

E. One dead shell by roadside, Long Stratton, 1890 (L. E. Adams).

HYGROMIA GRANULATA (Alder). [=*H. sericea*, Jeff]. Under dead willow-leaves in damp places.

E. Costessey, Ringland, Trowse (A.M.).

W. Weeting (A.M.).

HYGROMIA GRANULATA, var. CORNEA, Jeff.

E. Costessey Common (A.M.).

H. HISPIDA (Linné). [=*H. concinna*, Jeffreys]. A well-distributed but not abundant form, occurring sparingly throughout the county.

.. var. NANA, Jeff.

E. Whitlingham (S.S.P.).

W. West Winch (T.P.).

.. var. DEPILATA, Alder.

E. Costessey Common (A.M.).

.. var. ALBIDA, Jeff.

W. West Winch (T.P.).

H. SERICEA, Draparnaud (*non* Jeffreys). Much confusion has been made in this group and many of the snails recorded as *H. hispida*, L., var. *hispidosa*, Mousson [=*H. hispida*, Jeffreys] properly belong to the present species, which is common throughout the county.

E. Heigham, Earlham, Colney, Costessey, Thorpe, Postwick, Roydon Fen, Flordon Common (A.M.).

W. Blo Norton, Garboldisham, Thetford, Weeting (A.M.).

H. RUFESCENS (Pennant). Very common throughout the county on hedgebanks and in gardens.

.. var. RUBENS, Moq.-Tand.

E. Earlham (A.M.).

.. var. ALBA, Moq.-Tand.

E. Earlham (A.M.).

W. Castle Rising (T.P.).

.. var. DEPRESSA, Taylor.

E. Catton (A.M.). Yelverton (S.S.P.).

.. var. ALBOCINCTA, Ckll.

W. Lynn (T.P.).

ACANTHINULA ACULEATA (Müller). [=*Helix aculeata*]. Among dead leaves in woods and hedgerows.

E. Caistor, Arminghall (Bridgman), Heigham, Earlham, Stratton Strawless (A.M.).

W. Garboldisham (L. E. Adams), Blo Norton (A.M.).

VALLONIA PULCHELLA (Müller). [=*Helix pulchella*]. in moss and among dead leaves.

E. Yelverton, Brooke, Bramerton (S.S.P.), Heigham, Eaton, Earlham, Mousehold Heath, Roydon Fen, Flordon Common (A. M.).

W. Castle Rising, Bawsey, Middleton, Ringstead, North Wootton (T.P.).

V. COSTATA (Müller). [=*H. pulchella* var. *costata*].

E. Yelverton (S.S.P.), Earlham, Hellesdon (A.M.).

W. Generally found with *V. pulchella* (T.P.), Blo Norton (A. M).

V. EXCENTRICA, Sterki. Amongst moss and dead leaves.

E. Earlham, Roydon Fen (A.M.).

W. Blo Norton (A.M.).

HELICIGONA LAPICIDA (Linné). [=*Helix lapicida*]. In dry situations on chalky soil.

E. Framingham Pigott, between Yelverton and Framingham Earl, Halverston (S.S.P.), Upper Hellesdon, Ringland (A.M.), Thorpe, Dunston (Bridgman). Donnison's Hill, between Harleston and Shotford Bridge (Lindley H. Jones).

,, var. NIGRESCENS, Taylor.

E. Framingham Earl (S.S.P.).

H. ARBUSTORUM (Linné). On nettles in damp places. Common in the Yare Valley.

E. Whitlingham, Postwick, Bramerton (Bridgman) Thorpe (A.M.).

,, var. CINCTA, Taylor.

E. Brundall, Surlingham (S.S.P.), near Thorpe Asylum (A.M.).

,, var. FLAVESCENS, Moq.-Tand.

E. Brundall, Surlingham (S.S.P.), Thorpe (A.M.).

HELIX ASPERSA, Müller. Common everywhere.

,, var. MINOR, Moq.-Tand.

E. Yelverton, Alpington, Old Lakenham, Trowse (S.S.P.), Heigham, Hellesdon (A.M.).
W. Lynn, Hunstanton (T.P.).

,, var. CONOIDEA, Picard.
E. Yelverton (S.S.P.), Hellesdon (A.M.).

,, var. GRISEA, Moq.-Tand.
E. Yelverton (S.S.P.), Thorpe, Hellesdon, (A.M.).

,, var. EXALBIDA, Menke.
E. Yelverton, Alpington, Old Lakenham (S.S.P.), Thorpe, Hellesdon (A.M.), Catton (Bridgman).

,, var. FLAMMEA, Picard.
E. Earlham, Colney, Hellesdon, Drayton (A.M.).
W. West Winch, Lynn, Hunstanton (T.P.).

,, var. ALBO-FASCIATA, Jeff.
E. Drayton (A.M.).

,, var. TENUIOR, Shuttl.
E. Yelverton (A.M.).

,, var. ZONATA, Moq.-Tand.
E. Upper Hellesdon (A.M.).

H. NEMORALIS, Linné. Common throughout the county.

,, var. MINOR, Moq.-Tand.
E. Alpington (S.S.P.). Hethersett, Earlham, St. Faith's (A.M.).
W. Hunstanton, Wormegay (T.P.).

,, var. ROSEOLABIATA, Taylor.
E. Alpington (S.S.P.), Earlham (A.M.).

,, var. LIBELLULA, Risso.
E. Alpington, Yelverton, Thurton (S.S.P.), Earlham, Catton, Roydon Fen (A.M.).
W. Common about Lynn (T.P.).

,, var. RUBELLA, Moq.-Tand.
E. Thurton, Yelverton (S.S.P.), Earlham, Hellesdon, Hethersett, Catton (A.M.).
W. Common about Lynn (T.P.).

H. NEMORALIS, var. CASTANEA ,Moq.-Tand.
E. Alpington (S.S.P.), Earlham, Horsham St. Faith's (A.M.).
,, var. OLIVACEA, Risso.
E. Alpington (S.S.P.), Horsham St. Faith's (A.M.).
,, var. DIAPHANA, Moq.-Tand.
E. Yelverton (S.S.P.).
var. HYALOZONATA, Taylor.
E. Earlham (A.M.).
,, MONS. SINISTRORSUM.
E. Old Lakenham Churchyard (J. Chittock, Norwich Museum).

H. HORTENSIS, Müller. More local than the preceding.
var. FUSCOLABIATA, Taylor.
E. Alpington (S.S.P.), Brooke (A.M.).
,, var. ALBINA, Moq.-Tand.
E. Alpington, Rockland, Yelverton (S.S.P.). Brundall, Catton, Old Lakenham (A.M.).
W. Lynn (T.P.).
,, var. LUTEA, Moq.-Tand.
E. Alpington, Yelverton, Rockland, Hellington, Brooke, Burgh Apton (S.S.P.), Catton, Old Lakenham (A.M.).
W. The general form about Lynn (T.P.).
,, var. INCARNATA, Moq.-Tand.
E. Catton, Sprowston (A.M.).
W. Lynn (T.P.).
,, var. ARENICOLA, Macgill.
E. Yelverton (S.S.P.), Catton, Kirby Bedon, Bramerton (A.M.).
,, var. TENUIS, Baud
E. Yelverton (S.S.P.).
,, var. ROSEOZONATA, Ckll.
W. Lynn (T.P.).
,, var. LILACINA, Taylor.
W. North Runcton, Gaywood (T.P.).

ENA OBSCURA (Müller). [=*Bulimus obscurus*]. On damp hedgebanks. Local.

E. Earlham, Eaton, Poringland (A.M.), Thorpe (J. Reeve, Nor. Mus.).

W. Gaywood (T.P.).

[OPEAS GOODALLI (Miller). [=*Bulimus*]. An introduced species.

E. In Greenhouses at Carrow (Bridgman).]

COCHLICOPA LUBRICA (Müller). Common among dead leaves and moss in damp places.

E. Rockland St. Mary, Yelverton, Surlingham, Whitlingham (S.S.P.), Heigham, Earlham, Costessey, Thorpe, Roydon Fen Flordon Common (A.M.), Holt (T.P.), Woodbastwick (W. G. Clarke).

W. North Wootton, Wolferton, Hunstanton, Middleton (T.P.),

" var. LUBRICOIDES, Fér.

E. Whitlingham Marsh (S.S.P.).

AZECA TRIDENS (Pulteney). Very local.

E. On a ditch bank at Roydon (A.M.).

CÆCILIOIDES ACICULA (Müller). [=*Ichatina*]. At roots of grass.

E. Thorpe (Bridgman).

W. South Lopham Fen (A.M.).

JAMINIA CYLINDRACEA (da' Costa). [=*Pupa umbilicata*]. On old walls under ivy.

E. Yelverton Churchyard, Howe Churchyard (S.S.P.), Earlham, Thorpe, Weston, Kirby Bedon (A.M.).

W. Ringstead (T.P.).

J. MUSCORUM (Linné). [=*Pupa marginata*]. Under moss on sandy soil.

E. Bawburgh, Ringland, Hellesdon, Bramerton, Flordon Common (A.M.).

W. On the Town Wall, Lynn (T.P.).

J. MUSCORUM, var. EDENTULA, Clessin.
E. Roydon Fen (A.M.).
,, var. BIGRANATA, Rossm.
W. Thetford St. Peter (A.M.).
The tridentate form occurs at
W. Thetford St. Peter (A.M.).

VERTIGO ANTIVERTIGO (Drap.). In Marshes.
E. Old Lakenham (S. P. Woodward), Plentiful on Roydon Fen, Flordon Common (A.M.).
W. Castle Rising ("Victoria" County History).

V. SUBSTRIATA (Jeffreys). Among dead leaves and moss.
E. Near Diss (A.M.).
W. Bawsey (T.P.), Garboldisham (L. E. Adams).

V. PYGMÆA (Drap). In grass, moss, and dead leaves. Fairly common.
E. Yelverton Churchyard (S.S.P.), Earlham, Costessey, Ringland, Roydon Fen, Flordon Common (A.M.),
W. Middleton, Ringstead, Castle Rising (T.P.).
,, var. QUADRIDENTATA, Studer.
E. Roydon Fen (A.M.).
W. Abundant on dead stems, Gayton Road Station (T.P.).

V. MOULINSIANA (Dupuy). On fens and swampy ground. Very rare.
E. Roydon Fen (A.M.).

V. PUSILLA, Müller. Under dead leaves.
E. Earlham, Bowthorpe, Bramerton (A.M.).
W. Blo Norton (A.M.), Garboldisham (L. E. Adams).

V. ANGUSTIOR, Jeffreys. In marshy places. Rare.
E. Rather plentiful on Roydon Fen, Flordon Common (A.M.).
W. Hunstanton (A. S. Kennard).

BALEA PERVERSA (Linné). Under ivy on old walls, and on the bark of old trees. Not common.
E. Thorpe (Bridgman).
W. Blo Norton (A.M.).

CLAUSILIA LAMINATA (Montagu). Under fallen ash leaves.

E. Costessey, Framingham Earl (A.M.), Whitlingham Wood (Bridgman). Donnison's Hill, between Harleston and Shotford Bridge (Lindley H. Jones).

C. BIDENTATA (Ström). [= *C. rugosa*]. Common among grass and dead leaves, and on old walls under ivy.

E. Yelverton, Framingham Earl, Whitlingham (S.S.P.), Heigham, Earlham, Thorpe, Roydon (A.M.),

W. Middleton, Castle Rising (T.P.), Blo Norton (A.M.).

.. var. EVERETTI, Miller.

E. Earlham (A.M.).

.. var. TUMIDULA, Jeff.

E. Whitlingham (S.S.P.).

.. var. ALBINA, Moq.-Tand.

E. Yelverton Churchyard (S.S.P.).

SUCCINEA PUTRIS (Linné). On stems and leaves of plants by river-sides.

E. Salhouse, Brundall, Reedham, Bramerton, Burgh Apton (S.S.P.), Costessey, Colney, Thorpe (A.M.).

W. Common near Lynn (T.P.), Weeting (A.M.).

S. ELEGANS, Risso. More common than the preceding, and found in similar situations.

E. Near Yarmouth, Salhouse Broad, Surlingham, Brundall, Bramerton, Whitlingham, Trowse, Stoke Holy Cross (S.S.P.), Heigham, Hellesdon, Costessey, Thorpe, Old Lakenham, Roydon Fen, Flordon Common (A.M.), Cringleford, (L. E. Adams).

W. Gaywood, West Winch, Wormegay, Lynn (T.P.), Weeting, Blo Norton, Garboldisham (A.M.).

.. var. PFEIFFERI, Rossm.

E. Heigham (A.M.).

CARYCHIUM MINIMUM, Müll. Common under dead leaves in damp places.

E. Surlingham, Whitlingham, Bramerton (S.S.P.). Costessey, Earlham, Stratton Strawless, Haynford, Roydon Fen, Flordon Common (A.M.), Holt (T.P.). The Grove, Bracondale (Lindley H. Jones).

W. Castle Rising, Middleton, St. Germans, Hunstanton (T.P.), Blo Norton, Weeting (A.M.).

PHYTIA MYOSOTIS (Drap.). [=*Alexia*, Leach]. On ditch-banks near the sea.

E. Ditches near Breydon (A.M.).

OVATELLA BIDENTATA (Montagu). [=*Leuconia*, Gray].

W. At the roots of grass by the side of the railway bridge over the Ouse at Lynn (T.P.).

ANCYLUS FLUVIATILIS, Müller.

E. On stones and water-lily leaves in the River Wensum at Hellesdon (A.M.), River at Trowse (J. Reeve, Nor. Mus.).

W. Near the water-works, Lynn (T.P.).

ACROLOXUS LACUSTRIS (Linné). [=*Velletia*].

E. On water-lily leaves. Brundall, Surlingham, Acle, Heigham Bridge (S.S.P.), River Wensum at Heigham and Hellesdon (A.M.).

W. On reeds, St. Germans (T.P.).

var. COMPRESSA, Jeff.

E. In the River Yare at Brundall (S.S.P.).

LIMNÆA AURICULARIA (Linné). In rivers, fairly common.

E. River Yare between Norwich and Brundall. In the Bure above Acle Bridge, Thurne Stream. Heigham Sounds, Old Meadow Dyke (S.S.P.). River Wensum at Heigham and Hellesdon (A.M.).

W. Lynn, St. Germans, Setch, Babingley, West Winch (T.P.), Weeting (A.M.).

var. MINOR.

W. Setch (T.P.).

L. PEREGER (Müller). Common in rivers, ditches, and ponds throughout the county.

,, var. LACUSTRIS, Leach.
E. Brundall, Ranworth Broad (S.S.P.).
W. Lynn (T.P.).

,, var. VULGARIS, C. Pfeiffer.
E. In a ditch near Horsey Mere (S.S.P.).

,, var. INFLATA, Kob.
E. Ranworth Broad, Acle (S.S.P.).
W. West Winch (T.P.).

,, var. MARGARITANA, Esm.
E. Acle (S.S.P.). Heigham (A.M.).

,, var. CANDIDA, Porro.
E. Ditch near New Cut, Reedham (S.S.P.).

,, var. LABIOSA, Jeff.
W. In a pond on Wash bank, Lynn (T.P.).

,, var. MARITIMA, Jeff.
W. Reffley (T.P.).

,, var. OVATA, Drap.
W. Runcton (T.P.).

L. PALUSTRIS (Müller). In marshes and ditches.
E. Bramerton, Whitlingham, Brundall, Buckenham, Reedham, near Acle (S.S.P.), Colney, Thorpe, Postwick, Costessey, Heigham, Roydon Fen (A.M.).
W. Common in ditches to the south of Lynn, St. Germans, Babingley, North Wootton, Gaywood Setch (T.P.), Weeting (A.M.).

,, var. TINCTA, Jeff.
E. Brundall, Reedham (S.S.P.).

,, var. CARINATA, Pearce.
E. In a ditch by the side of the New Cut, Reedham (S.S.P.).

,, var. ELONGATA, Moq.-Tand.
W. Lynn (T.P.).

,, var. MINOR.
W. North Wootton (T.P.).

L. PALUSTRIS, var. VARIEGATA.

W. Ditch near the Ouse, Lynn (T.P.).

,, var. ROSEOLABIATA, Jeff.

W. Saddlebow, Lynn (T.P.).

L. TRUNCATULA (Müller). In marshes and ditches.

E. Banks of the river at Bramerton, Ditches on Costessey Common, Roydon Fen, Flordon Common (A.M.), Holt (T.P.), Whitlingham (Bridgman).

W. Gaywood, North Wootton, Hardwick, St. Germans, Hunstanton (T.P.), Weeting (A.M.).

L. STAGNALIS (Linné). Rivers, ditches, and ponds. Common.

E. Acle, Bramerton, Whitlingham Marsh, Stoke Holy Cross (S.S.P.), Old Lakenham, Earlham, Weston (A.M.). Pond on Harleston Common (Lindley H. Jones).

W. Gaywood, North Runcton, Saddlebow, St. Germans, North Wootton, Babingley (T.P.). Abundant in Ring Mere and Lang Mere (A.M.).

,, var. FRAGILIS, Linné.

W. Found with the type (T.P.).

,, var. PICTA.

W. Ditch near St. Germans (T.P.).

L. GLABRA Müller).

W. In shallow ponds at Reffley and North Runcton (T.P.).

AMPHIPEPLEA GLUTINOSA (Müller).

E. In a ditch at Colney. In the River Wensum at Heigham and Hellesdon (A.M.), Keswick (Bridgman).

,, var. ALBIDA, Williams.

E. With the type at Colney (A.M.).

PLANORBIS CORNEUS (Linné). In ditches. Fairly common.

E. Acle, Bramerton, Postwick Grove, Whitlingham (S.S.P.). Colney, Thorpe, Roydon Fen (A.M.).

W. Gaywood, Lynn, Middleton, Watlington (T.P.). Blo Norton, Weeting (A.M.).

P. ALBUS, Müller. Common.

E. Ditches at Acle and Horning Ferry. River Yare at Brundall and Coldham Hall, River Taas at Stoke Holy Cross (S.S.P). Ditches at Colney and Hellesdon (A.M.).

W. Hunstanton, Lynn, Wormegay, St. Germans. West Winch (T.P.). Weeting (A.M.).

P. GLABER, Jeff. Rare.

E. River Wensum at Heigham (Bridgman).

P. CRISTA (Linné). [=*P. nautileus*]. In ponds and ditches. Rather local.

E. Ditch near Horning Ferry (S.S.P.). Pond at Bawburgh, Roydon Fen (A.M.).

W. West Winch (T.P.).

,, var. LEVIGATA, Adami.

E. Pond on Mousehold Heath (A.M.).

P. CARINATUS, Müller. Common in ditches.

E. Acle, Horning Ferry, Heigham Bridge, near New Cut, Reedham, Stoke Holy Cross (S.S.P.) Colney, Heigham, Hellesdon, Roydon Fen (A.M.).

W. Saddlebow, Gaywood, Watlington (T.P.). Blo Norton, Weeting, (A.M.).

,, var. DISCIFORMIS, Jeff.

E. Colney (A.M.).

P. UMBILICATUS, Müller. [=*P. complanatus*]. Very common and abundant in ditches, ponds, and rivers throughout the county.

,, var. RHOMBEA, Turton.

E. Ditches near Yarmouth (A.M.).

W. In a ditch at Saddlebow (T.P.).

P. VORTEX (Linné).

E. Brundall, Bramerton, Stoke Holy Cross, Acle, Reedham, Whitlingham (S.S.P.), Colney, Heigham, Hellesdon, Thorpe, Costessey, Flordon Common (A.M.).

W. Common in ditches and ponds near Lynn (T.P.). Blo Norton, Weeting (A.M.).

P. SPIRORBIS (Linné).

E. Whitlingham, Bramerton, Brundall, Surlingham Ferry, ditch near Reedham New Cut, ditches at Stoke Holy Cross, Acle, Horning Ferry, Horsey Mere, Heigham Bridge (S.S.P.), Ditch at Thorpe, Roydon Fen (A.M.).

W. Gaywood, Reffley, North Runcton (T.P.).

P. CONTORTUS (Linné).

E. Ditches at Whitlingham, Bramerton, Surlingham, Brundall, Buckenham Ferry, Stoke Holy Cross, Acle, Horning Ferry (S.S.P.), Colney, Thorpe, Postwick Roydon Fen (A.M.).

W. Babingley, North Wootton, Watlington, Gaywood, St. Germans (T.P.), Blo Norton (A.M.).

P. FONTANUS (Lightfoot). [=*P nitidus*].

E. In ditches at Bramerton, Horning Ferry, near Whitlingham Church (S.S.P.), Colney, Hellesdon Roydon Fen (A.M.).

W. Common in ditches round Lynn, Wormegay, North Wootton, Watlington (T.P.).

SEGMENTINA NITIDA (Müller). [=*Planorbis lineatus*]. Very local.

E. Whitlingham Marsh (S.S.P.), Thorpe (A.M.), Heigham (Bridgman).

W. Amongst reeds on the Recreation Ground, Lynn. (T.P.).

PHYSA FONTINALIS (Linné). Very common in all rivers, broads, and large ditches.

APLECTA HYPNORUM (Linné). Very local.

E. In a ditch at Thorpe (A.M.).

W. Ditch at St. Germans (T.P.).

,, mons. DECOLLATUM, Nelson.

E. With type at Thorpe (A.M.).

PALUDESTRINA STAGNALIS, Bast. [=*Hydrobia ulvæ*]. Common in brackish waters.

E. Breydon (A.M.).

W. Wells, Burnham Overy (A.M.).

P. VENTROSA (Montagu). Ditches near the sea.

E. Near Breydon (A.M.).

W. Lynn, Hunstanton (T.P.).

P. JENKINSI, Smith.

E. In a ditch near Breydon (A.M.).

BITHYNIA TENTACULATA (Linné). In rivers and ditches. Common throughout the county.

B. LEACHII (Sheppard). More local than preceding species.

E. Ditch at Horning Ferry, Acle, by New Cut at Reedham, Whitlingham, Stoke Holy Cross (S.S.P.), Colney, Heigham, Thorpe (A.M.), Cringleford (L. E. Adams).

W. North Wootton, Gaywood, Lynn, Saddlebow, West Winch (T.P.), In the Little Ouse at Weeting (A.M.).

,, var. ELONGATA, Jeff

E. Surlingham Ferry (S.S.P.)

,, var. ALBIDA, Rimmer.

W. South Lynn (T.P.).

VIVIPARA VIVIPARA (Linné). [=*Paludina*]. In rivers.

E. Brundall, Bramerton, Surlingham, Wroxham, Horning Ferry (S.S.P.), Heigham, Hellesdon, Postwick (A.M.).

W. Weeting (A.M.).

V. CONTECTA (Millet). In rivers and ditches.

E. River Bure at Acle, Horning, Wroxham. River Yare at Bramerton, Surlingham, Brundall (S.S.P.), Ditches in the Wensum valley at Heigham, Hellesdon and Costessey. Ditches at Colney and Thorpe, Roydon Fen (A.M.). Cringleford (L. E. Adams).

W. Wormegay (T.P.), Blo Norton, South Lopham (A.M.).

VALVATA PISCINALIS (Müller).

E. Plentiful in ditches, streams, and broads of the Yare and Bure valleys (S.S.P.). Colney, Costessey, Thorpe (A.M.).

W. Babingley, North Wootton, Gaywood, Setch, Hunstanton, West Winch, St. Germans (T.P.), Blo Norton, South Lopham, Weeting (A.M.).

V. CRISTATA, Müller.

E. Ditches at Horning Ferry, Postwick Grove, Whitlingham Marsh (S.S.P.), Arminghall, Thorpe, Colney, Roydon Fen, Flordon Common (A.M.). Old Lakenham (Lindley H. Jones).

W. Gaywood, St. Germans, North Wootton, West Winch (T.P.), Blo Norton, Weeting (A.M.).

POMATIAS ELEGANS (Müller). [=*Cyclostoma*]. On chalky soil. Rare.

E. Whitlingham Wood. Hedgebank at Drayton (A.M.).

ACICULA LINEATA (Drap). [=*Acme lineata*]. Under dead leaves in woods. Very rare.

E. Two specimens, Caistor Wood (Bridgman).

NERITINA FLUVIATILIS (Linné). On stones in the bed of rivers.

E. Surlingham Ferry, Brundall. In the Bure between Salhouse Broad and Horning, Old Meadow Dyke, Horsey Mere, Heigham Sounds (S.S.P.), In the River Wensum at Heigham and Hellesdon (A.M.).

W. The Little Ouse at Weeting (A.M.),

,, var. PALLIDA, Pascal.

E. Heigham (A.M.)

,, var. TRIFASCIATA, Colb.

E. Heigham (A.M.).

DREISSENSIA POLYMORPHA (Pallas).

E. Breydon (Bridgman).

UNIO PICTORUM, (Linné).

E. Postwick, Whitlingham, Trowse, Surlingham, Brundall, Wroxham, Acle, Thurne Stream, Heigham Sounds (S.S.P.), Heigham, Hellesdon (A.M.).

,, var. COMPRESSA, Jeff.

E. At the bends of the River Yare near Surlingham Ferry and Bramerton (Bridgman.

ANODONTA CYGNÆA (Linné).

E. In the Yare and Bure, Postwick, Bramerton, Acle (S.S.P.), Heigham, Hellesdon (A.M.).

W. North Wootton (T.P.), Weeting (A.M.).

,, var. ANATINA, Linné.

E. In the rivers Yare and Bure (S.S.P.). In the Wensum at Heigham and Hellesdon (A.M.).

W. Blo Norton (A.M.).

SPHÆRIUM CORNEUM (Linné). Very common in ponds, ditches and rivers.

,, var. VITTATA.

W. Saddlebow (T.P.).

,, var. FLAVESCENS, Macgill.

E. Horning Ferry, Brundall (S.S.P.), Colney (A.M.).

,, var. NUCLEUS, Stud.

E. Bramerton, Whitlingham (S.S.P.).

W. St. Germans (T.P.).

,, var. PISIDIOIDES, Gray.

E. Brundall (S.S.P.), Colney (A.M.).

S. LACUSTRE (Müller).

E. In the Bure and Yare valleys at Surlingham Ferry, Brundall, Horning (S.S.P.), Thorpe, Old Lakenham, Colney (A.M.), Holt (T.P.), Heigham (Bridgman).

W. Lynn, Wormegay, Saddlebow (T.P.).

PISIDIUM AMNICUM (Müller.)

E. Bramerton, Brundall, Coldham Hall, Stoke Holy Cross (S.S.P.), Colney, Thorpe, Old Lakenham (A.M.).

W. Wormegay (T.P.), Weeting (A.M.).

P. HENSLOWIANUM (Sheppard). In ditches. Rare.

W. Lynn (Bridgman).

P. SUBTRUNCATUM, Malm. [= *P. fontinale*, Jeff). In ditches and rivers. Common.

E. Stoke Holy Cross, Surlingham Ferry, Horning Ferry, Ranworth Broad (S.S.P.), Thorpe, Old Lakenham, Swainsthorpe, Costessey (A.M.), Holt (T.P.).

W. Babingley, North Wootton (T.P.), Weeting (A.M.).

P. PULCHELLUM, Jenyns. In ditches. Local.

E. Stoke Holy Cross (S.S.P.), Colney, Flordon Common (A.M.).

W. Gaywood (T.P.).

P. PUSILLUM (Gmelin). In ditches, marshes, etc.

E. Hickling Broad (S.S.P.), Costessey, Old Lakenham (A.M.), Thorpe (Bridgman).

W. St. Germans, Babingley, North Wootton, Gaywood ((T.P.).

P. OBTUSALE, Pfeiffer. In ditches. Local.

E. Colney, Swainsthorpe, Roydon Fen (A.M.).

W. St. Germans (T.P.).

P. NITIDUM, Jenyns. In marshy places. Local.

E. Roydon Fen (A.M.).

W. In a ditch near Thetford. Pond near Ring Mere (A.M.).

P. GASSIESIANUM, Dupuy. [=*P. roseum*, Jeff. =*P. milium*, Auctt]. Ditches. Local.

E. Old Lakenham (A.M.), Heigham (Bridgman).

W. West Winch, St. Germans (T.P.).

XV.

FAUNA AND FLORA OF NORFOLK.

Additions to Part X. Marine Algæ.

By Rev. E. N. Bloomfield, M.A.

In our 'Transactions,' Vol. III., Part IV., p. 532-539, the late Mr. H. D. Geldart published a list of the Marine Algæ which have been found on the coast of Norfolk. Since that time, as far as I am aware, we have had no further records. The following additional species and varieties are, however, recorded for Norfolk in Mr. E. A. L. Batter's 'Catalogue of British Marine Algæ.' These therefore are here given to supplement Mr. Geldart's list.

Some few of these are of considerable rarity, some are obscure and apparently only lately recognised as British, while others are varieties of common species.

MELANOSPERMEÆ.

Cystoseira discors, Ag. (*C. fœniculacea*, Grev.). Yarmouth.
Laminaria saccharina var. latissima, Turner. Yarmouth.
Sphacelaria cirrhosa, δ fusca. Holm & Batt. Cley.
Ectocarpus siliculosus, ε subulatus. Hauck. Cley.
Pylaiella litoralis, β firma. Kjellm. Yarmouth & Cromer.

RHODOSPERMEÆ.

Catenella repens, Batt. (*C. Opuntia*, Grev.). Cley.
Colacolepis incrustans, Schm. Yarmouth, parasitic on *Phyllophora rubens*.
Ceramium Deslongchampsii. Chauv. Yarmouth.
,, flabelligerum. Yarmouth.
,, acanthonotum, Carm. Norfolk.
Dilsea (Iridia) edulis. Stackh. Norfolk.
Atrochætium secundatum. Näg. Yarmouth.

CHLOROSPERMEÆ.

ENTEROMORPHA MINIMA, Näg. Yarmouth.
VAUCHERIA SPHÆROSPORA, f. DIOICA, Rosenv. Cley.
GOMONTIA POLYRHIZA, Born. & Flah. Cromer. Immersed in the chalky shells of several species of Mollusca.
PILINIA RIMOSA, Kütz. Yarmouth.
BLASTOPHYSA RHIZOPUS, Rke. Yarmouth.
PRASIOLA STIPITATA, Suhr. Yarmouth.
ANABÆNA TORULOSA, Lagerh. Cley.
CALOTHRIX CONSOCIATA, Born. & Flah. Cley. A rare species.
LYNGBYA SEMIPLENA, J. Ag. Yarmouth.
DERMOCARPA SCHOUSBŒI, Born. Yarmouth.

XVI.

FAUNA AND FLORA OF NORFOLK.

PART XII. PHYTOPHAGOUS HYMENOPTERA (SAWFLIES).

BY REV. E. N. BLOOMFIELD, M.A., F.E.S.

With the assistance of Mr. E. A. Atmore, F.E.S.

IN our 'Transactions' for the year 1887—1888,* Mr. J. B. Bridgman published a list of the Norfolk Sawflies in which he enumerates 157 species. Since Mr. Bridgman's death only four species have been added, viz., in the 'Transactions' for 1901—1902. Of late, however, Mr. Atmore has collected them assiduously, and has taken many species, some of great

* Vol. iv. pp. 523—536.

rarity, which are not contained in the former list. The Rev. F. D. Morice, M.A., F.E.S., the author of 'Help Notes towards the Determination of British Tenthredinidæ,' has most kindly examined and determined most of Mr. Atmore's specimens, and has also supplied the most recent nomenclature, that of Konow, who until his recent death was the chief authority on the Tenthredinidæ. This nomenclature differs very materially from that employed by Mr. Bridgman, which is mainly the same as that of Mr. Cameron in his Monograph of British Phytophagous Hymenoptera. It has been therefore thought best to publish a complete list. In many cases Mr. Cameron's names are also given as synonyms. All the localities are those of the original lists with the exception of King's Lynn where within a radius of six or seven miles all Mr. Atmore's captures have been made. The number and rarity of the species recorded is remarkable and bears testimony to the very successful collecting both of Mr. J. B. Bridgman and Mr. Atmore.

The species marked * are new to the Norfolk list.

TENTHREDINIDÆ.

Lydini.

Pamphilius *hortorum, Klug. One at King's Lynn on May 31st, 1908.

,, *gyllenhali, Dahlb. One female taken at King's Lynn on flowers of Heracleum in June, 1903. The second British specimen.

,, *pallipes, Zett. King's Lynn, one female, May, 1907. The first undoubted British specimen.

,, silvaticus, L. A Norfolk species, Curtis. Two specimens taken by Mr. Bridgman at Norwich.

Cephini.

Macrocephus linearis, Schrank. Surlingham and Rockland, C. Morley.

Cephus pallipes, Klng. (phthisicus). Felthorpe and King's Lynn.

,, pygmæus, L. Very common.

Janus *cynosbati, F. Two males at King's Lynn.

Trachelus tabidus, F. Earlham once, King's Lynn not common.

Xyelini.

Xyela julii, Breb. Three males taken on umbelliferous plants in Norfolk, Curtis. A rare species.

Siricini.

Sirex gigas, L. Wooded districts about King's Lynn, &c.

,, noctilio, F. (juvencus). King's Lynn, &c., not so common as *S. gigas*, but not rare.

Cimbicini.

Cimbex femorata, L. (sylvarum). Norfolk, Stephens.

Trichiosoma lucorum, L. ?, Sparham, F. Norgate. King's Lynn, rare, bred from birch.

,, tibialis, Leach (betuleti). Common on whitethorn near Norwich. King's Lynn.

,, *silvatica, Leach ?. King's Lynn bred from birch, it usually feeds on willow.

Abia sericea, L. Dilham, F. Norgate. Brundall sparingly.

,, *fasciata, L. One male at King's Lynn, July, 1908. The males of this species are very rare.

Argini (Hylotomini).

Arge *cærulescens, Geoffr. (cyanella). King's Lynn, not common.

,, ustulata, L. Eaton, &c., but not common; King's Lynn frequent.

,, atrata, Forst. One female at Sparham in July. F. Norgate.

,, cyanocrocea, Forst. Norwich, common. King's Lynn scarce.

,, rosæ, De G. Norfolk, Stephens.

Schizoceros *furcatus, Vill. One male at King's Lynn in 1904; a very rare species.

,, *geminatus, Gir. King's Lynn, one in August, 1906.

Lophyrini.

Lophyrus, sp. ? Larvæ at Thetford, Mr. Dale; Felthorpe and King's Lynn.

TENTHREDININI.

Nematides.

Cladius pectinicornis, Fourcr. Common.

Trichiocampus ulmi, L. (rufipes). Eaton once, August, 1881. King's Lynn rare.

,, drewseni, Thoms.

,, eradiatus, Htg. var. præcedentes. This and T. drewseni are not uncommon near Norwich in May and June.

Priophorus padi, L. Abundant.

,, *tristis, Zadd. (brullæi). King's Lynn, June 3rd, 1908.

Hemichroa alni, L. Common in June. Mr. Bridgman twice bred the very rare male, and Mr. Atmore took one in June, 1907.

,, crocea, Geoffr. (rufa). One bred from larva, taken near Norwich.

Leptocercus (Camponiscus) *duplex, Lep. King's Lynn, not uncommon.

,, *luridiventris, Fall. A female at King's Lynn, 1908.

Dineura nigricans, Christ. (viridiventris). Two near Norwich: common at King's Lynn.

,, stilata, Klug. Very common.

Micronematus monogynlæ, Htg. (hibernicus). Two at Norwich. One at King's Lynn.

Cryptocampus (Euura) *ater, Jur. King's Lynn in 1907 and 1908.

Pontania *bipartita, Lep. (aurantiacus). King's Lynn, one in July, 1907.

,, xanthogastra, Forst. Norwich and Brundall, common.

,, leucosticta, Htg. Brundall in June; King's Lynn, very common.

,, viminalis Htg. (Bridgmani). Brundall and King's Lynn.

,, proxima, Lep. (gallicola). Very common.

NEMATUS ABDOMINALIS, Pz. One at Heigham ; one at King's Lynn.

,, *ACUMINATUS, Thoms. King's Lynn, four females, June, 1906 and 1908.

,, LUTEUS, F. (ruficapillus). Very common, near Norwich, King's Lynn, one in June, 1906.

CRŒSUS SEPTENTRIONALIS, L. Downham. F. Norgate.

,, LATIPES, Vill. King's Lynn, May, 1887.

HOLCOCNEME LUCIDA, Pz. Norwich, Sparham, and King's Lynn, not common.

,, CÆRULEOCARPA, Htg. Eaton, two males in June.

,, *ERICHSONI, Htg. King's Lynn, June, 1908. A rare and local species.

PTERONUS RIBESII, Scop. Very common.

,, *LEUCOTROCHUS, Htg. King's Lynn, not common.

,, MYOSOTIDIS, F. Common.

,, HORTENSIS, Htg. (tibialis), Once taken, J. B.

,, VIRESCENS, Htg. King's Lynn, common.

,, CURTISPINIS, Thoms. Once at Heigham.

,, OLIGOSPILUS, Först (miliaris). Common.

,, *POLYSPILUS, Först (glutionosæ). King's Lynn, scarce.

,, *BREVIVALVIS, Thoms. (croceus). King's Lynn, common.

,, *BERGMANNI, Dhlb. King's Lynn, not common.

,, *TESTACEUS, Thoms. King's Lynn scarce.

AMAURONEMATUS *FALLAX, Lep. King's Lynn, two in June.

,, *MUNDUS, Knw. King's Lynn, one in May, 1907.

,, *VITTATUS, Lep. King's Lynn, common among *Salix repens* in May, 1908.

,, *AMPLUS, Knw. King's Lynn, scarce.

PACHYNEMATUS *TURGIDUS, Zadd. King's Lynn, one only in August, 1906.

,, *FLAVIVENTRIS, Htg. Several at King's Lynn.

,, TRISIGNATUS, Först. (capreæ). Common.

,, *CLITELLATUS, Lep. (imperfectus). King's Lynn, not common.

,, *XANTHOCARPUS, Htg. King's Lynn, several.

PACHYNEMATUS ALBIPENNIS, Htg. Felthorp, Brundall and Heigham.

,, VAGUS, F. (leucogaster). Brundall, Felthorp, King's Lynn.

,, OBDUCTUS, Htg. Norwich, Brundall and King's Lynn, not uncommon.

,, *RUMICIS, Fall. King's Lynn, one in June, 1907.

,, *SCUTELLATUS, Htg. King's Lynn, common.

PRISTIPHORA *MELANOCARPA, Htg. King's Lynn, once in May, 1906.

,, FULVIPES, Fall. Brundall in July and August, King's Lynn.

,, CRASSICORNIS, Htg. Norwich and King's Lynn, not uncommon.

,, *RUFICORNIS, Ol. King's Lynn, scarce.

,, PALLIPES, Lep. (appendiculatus). Norwich and King's Lynn.

,, *SUBBIFIDA, Thoms. King's Lynn, twice taken.

LYGÆONEMATUS *SAXESENI, Htg. King's Lynn, locally common among Spruce firs.

,, *PINI, Retz. King's Lynn, scarce: both this and preceding species are rare and local.

,, *LARICIS, Htg. King's Lynn, six in 1908.

HOPLOCAMPIDES.

PHYLLOTOMA *NEMORATA, Fall. King's Lynn, frequent.

,, MICROCEPHALA, Klug. Norwich, Brundall and King's Lynn.

,, VAGANS, Fall. Common on alder.

ERIOCAMPOIDES ÆTHIOPS, F. (rosæ). Wroxham, common at Norwich.

,, LIMACINA, Retz. Frequent on fruit trees, J. B.

,, VARIPES, Klug. Common.

,, ANNULIPES, Klug. Norwich, and Brundall, common

,, CINXIA, Klug. Once at Earlham, August, 1878.

HOPLOCAMPA *TESTUDINEA, Klug. King's Lynn, one in 1908. The larva of this species feeds within young apples and causes them to fall prematurely.

,, *PECTORALIS, Thoms. King's Lynn, June, 1902.

Hoplocampa cratægi, Klug. Common on whitethorn flowers.
,, ferruginea, Pz. Norfolk, Stephens.
,, *chrysorhœa, Klug. King's Lynn, three females.

Blennocampides.

Mesoneura opaca, F. (Dineura verna). Norwich, King's Lynn, scarce.
Periclista *melanocephala, F. King's Lynn, four females.
,, *lineolata, Klug. King's Lynn, one in May, 1903.
Ardis plana, Klug. ?, (sericans). Brundall.
Tomostethus fuliginosus, Schr. Brundall, Norwich, not uncommon.
,, nigritus, F. Norwich, not uncommon.
,, dubius, Gmel. (ephippium). Frequent.
,, luteiventris, Klug. (fuscipennis). Common in marshy neighbourhoods, Brundall, &c.
Blennocampa assimilis, Fall. Norwich and King's Lynn, scarce.
,, pusilla, Klug. Norwich, common in May and June; King's Lynn, scarce.
,, *geniculata, Steph. (alternipes). King's Lynn, not common.
,, subcana, Zadd. (subserrata). Brundall, not uncommon.
Scolioneura *nana, Klug. King's Lynn, not uncommon.
,, betuleti, Klug. On Mousehold Heath, August, 1880. King's Lynn, a male and female, May 30th, 1906.
Monophadnus albipes, Gmel. Norwich, Brundall.
,, *geniculatus, Htg. King's Lynn, two males.
,, ruficruris, Brullé. Brundall and Norwich in some numbers.
Kaliosysphinga ulmi, Sunder. Near Norwich, locally common.
,, *dohrni, Tischb. King's Lynn, one in 1907.
,, melanopoda, Cam. Heigham Osier Car formerly; on alder in July.
Fenusa pumila, Klug. Norwich, bred from birch leaves.

FENUSA PYGMÆA, Klug. Earlham and King's Lynn, once at each.

,, THOMSONI, Knw. (*pumilio*). Norwich in May and August.

SELANDRIADES.

HARPIPHORUS *LEPIDUS, Klug. King's Lynn, not common.

ATHALIA SPINARUM, F. Formerly very destructive to turnips scarcely seen in Norfolk since 1830.

,, LUGENS, Klug. Brundall and King's Lynn, rare.

,, GLABRICOLLIS, Thoms. (ancilla). Not uncommon in June.

,, LINEOLATA, Lep. (rosæ). Very common.

SELANDRIA FLAVENS, Klug. Brundall. May to July.

,, SERVA, F. Common.

,, SIXII, Vollenh. Brundall and Heigham Osier Car, formerly.

,, STRAMINEIPES, Klug. Common.

,, MORIO, F. Brundall in August.

,, CINEREIPES, Klug. (aperta). Buckenham: King's Lynn, scarce.

STRONGYLOGASTER CINGULATUS, F. Very common among ferns; the male is rare.

THRINAX *MACULA, Klug. King's Lynn, six speciments.

STROMBOCEROS *DELICATULUS, Fall. King's Lynn, not uncommon.

ERIOCAMPA OVATA, L. Common on alder.

PŒCILOSOMA ABDOMINALIS, F. (luteolum). Not uncommon in marshy places.

,, PULVERATA, Retz. Sparham, F. Norgate: Brundall. King's Lynn.

,, EXCISA, Thoms. Once at Earlham in August.

,, LITURATA, Gmel. (submuticum). Strumpshaw and Brundall.

,, *IMMERSA, Klug. (fletcheri). King's Lynn, scarce.

,, LONGICORNIS, Thoms. Norwich in May and June.

EMPHYTUS TOGATUS, Pz. Sparham, F. Norgate; Earlham.

EMPHYTUS CINCTUS, L. Common on roses, J. B. King's Lynn occasionally,

,, CALCEATUS, Klug. Brundall in August.

,, BRACCATUS, Gmel. (tibialis). Sparham, F. Norgate. and King's Lynn in September.

,, GROSSULARIÆ, Klug. Norwich and King's Lynn occasionally.

,, CARPINI, Htg. Norwich frequent in May; King's Lynn, scarce.

,, TENER, Fall. Norwich, common at midsummer. King's Lynn, not common.

,, PERLA, Klug. Heigham Osier Car, once long ago,

TAXONUS GLABRATUS, Fall. Common.

,, EQUISETI, Fall. Common, J. B. King's Lynn, scarce.

DOLERIDES.

DOLERUS PRATENSIS, Fall. (fulviventris). Common.

,, *AERICEPS, Thoms. King's Lynn, not common.

,, *PALUSTRIS, Klug. King's Lynn, not uncommon.

,, *MADIDUS, Klug. (lateritius). King's Lynn, common.

,, *ANTICUS, Klug. King's Lynn, once.

,, THOMSONI, Knw. ? (anticus Cam.). Brundall once. This is probably Mr. Bridgman's species.

,, GONAGER, F. Common.

,, PUNCTICOLLIS, Thoms. Brundall, scarce.

,, HÆMATODES, Schr. Common, J. B. King's Lynn, scarce.

,, NIGRATUS, Mull. (fissus). Common, J. B. and King's Lynn, scarce.

,, PICIPES, Klug. (intermedius). Norwich, Brundall, Kings' Lynn, in April and May.

,, NIGER, L. Common. in June, J. B.

,, RAVUS, Zadd. (æneus). Not uncommon.

,, CORUSCANS, Knw. Eaton once, King's Lynn. Not uncommon; an early species.

LODERUS VESTIGIALIS, Klug. Norwich, Brundall, and King's Lynn, scarce.

TENTHREDINIDES.

RHOGOGASTERA PICTA, Klug. Mousehold Heath in 1887.

,, VIRIDIS, L. Common.

,, PUNCTULATA, Klug. Common. J. B.

,, FULVIPES, Scop. (lateralis). Norwich, not common. King's Lynn, common.

,, AUCUPARIÆ, Klug. (gibbosa). Common, a very early species.

TENTHREDOPSIS LITTERATA, Geoff. (cordata, &c). Not common.

,, var. CERASI, F. (microcephala). Norwich and King's Lynn.

,, TILIÆ, F. (sordida, &c.). Common in June. J. B.

,, DORSALIS, Lep. (inornata). Norwich, not uncommon, and once at King's Lynn,

,, COQUEBERTI, Klug. (nigricollis, &c.). Common.

,, *CAMPESTRIS, L. (scutellaris). King's Lynn, common.

,, *GIBBEROSA, Knw. King's Lynn, one female in 1907.

,, *TRISTIS, Steph. King's Lynn once in June.

,, EXCISA, Thoms. (ornata). Salhouse in June, and King's Lynn.

PACHYPROTASIS RAPÆ, L. Very common.

,, *ANTENNATA, Klug. King's Lynn. Three or four specimens.

,, SIMULANS, Klug. Once at Sparham, F. Norgate. A rare species.

MACROPHYA RUSTICA, L. Norwich, common in June; King's Lynn.

,, RIBIS, Schr. Brundall and Eaton. J. B. King's Lynn, common.

,, ALBICINCTA, Schr. Brundall, not uncommon. King's Lynn.

,, 12 PUNCTATA, L. Wroxham and King's Lynn, once at each.

MACROPHYA PUNCTUM-ALBUM, L. Not uncommon, near Norwich on privet fences in June; King's Lynn, once.

,, BLANDA, F. Norwich, common in June, J. B.; King's Lynn, frequent.

,, ANNULATA, Geoff. (neglecta). Norwich, common in June, J. B.; King's Lynn, frequent.

ALLANTUS MACULATUS, Fourc. Once at Sparham, F. Norgate.

,, TEMULUS, Scop. (T. bicinctus). Common.

,, SCROPHULARIÆ, L. Brundall, Postwick, and King's Lynn, not uncommon.

,, *FLAVIPES, Fourc. One at King's Lynn, June 18th, 1905. A rare species.

,, VESPA, Ratz. (tricinctus). Brundall in August.

,, OMISSUS, Forst, (marginellus). Earlham in June.

,, ARCUATUS, Forst, Very common.

TENTHREDO RUFIVENTRIS, F. Sparham, F. Norgate. King's Lynn, not common.

,, *BALTEATA, Klug. King's Lynn, not common.

,, LIVIDA, L. Very common.

,, FAGI, Pz. (solitaria). Two females at Sparham. F. Norgate.

,, COLON, Klug. Mousehold, one female many years ago.

,, MONILIATA, Klug. Rockland, C. Morley.

,, ATRA, L. Rockland and Eaton, C. Morley; King's Lynn, scarce.

,, var. DISPAR, Klug. Twice in Norfolk, J. B.

,, MESOMELÆNA, L. Very common.

,, var, OBSOLETA, Klug. One female at King's Lynn.

,, OLIVACEA, Htg. One by F. Norgate, one by J. Edwards.

XVII.

FAUNA AND FLORA OF NORFOLK.

Part IX. Hymenoptera.

[Further Additions.]

Chrysididæ and Aculeata.

By E. A. Atmore, F.E.S.

During the last few years, I have given considerable attention to these interesting groups of insects, and it is considered that the time has come for the publication of a supplementary county list. Certainly the number of species already recorded is so large that it would be unreasonable to expect many additions thereto. However, after carefully going through the previous lists contributed by my friend the late Mr. J. B. Bridgman, and published from time to time in the 'Transactions' of the Society, I have come to the conclusion that there is sufficient material to warrant the issue of a further list. All the 27 species which I am about to add to the Norfolk Fauna have been taken by myself, and unless otherwise stated, within a radius of about eight miles of King's Lynn. I wish to thank the Rev. E. N. Bloomfield for useful hints and assistance given me in compiling these notes; my thanks are also particularly due to Mr. Edward Saunders and the Rev. F. D. Morice, who have very kindly examined and determined many specimens for me.

Chrysididæ.

Hedychridium integrum, Dhlb. A rare species, King's Lynn, three specimens, 1905 and 1906.

Chrysis succincta, L. King's Lynn, not uncommon on one sandy bank.

Fossores.

METHOCA ICHNEUMONIDES, Latr. King's Lynn; I met with three females running on sand in 1907.

POMPILUS MINUTULUS, Dhlb. King's Lynn, rather common.

,, SPISSUS, Schiödte. King's Lynn, a single specimen taken in June, 1902.

,, CHALYBEATUS, Schiödte. King's Lynn, of frequent occurrence.

,, UNGUICULARIS, Thoms. King's Lynn, scarce. I have met with two females.

ASTATUS STIGMA, Panz. A scarce species. King's Lynn; I have taken two only, a male in July, 1907, and a female in July, 1908.

TACHYSPHEX UNICOLOR, Panz. King's Lynn; usually considered an uncommon or even rare species, but I have met with it annually for the last five or six years.

MIMESA UNICOLOR, V. d. Lind. King's Lynn. Two specimens.

PSEN CONCOLOR, Dhlb. A very rare species. King's Lynn; I took one in June, 1905, and another in July, 1907.

CERCERIS INTERRUPTA, Panz. King's Lynn, one specimen.

OXYBELUS MUCRONATUS, Fab. King's Lynn. Common in one sandy spot, but very local. It is an exceedingly active insect, and difficult to capture.

CRABRO PUBESCENS, Schuck. King's Lynn, two specimens, one in June, 1906, and the other in June, 1907.

,, CETRATUS, Schuck. King's Lynn. Four specimens from June to August, 1906 and 1907.

,, CAPITOSUS, Schuck. A rare species; King's Lynn. I took a single female June 18th, 1905.

,, VAGABUNDUS, Panz. King's Lynn, two males.

,, SCUTELLATUS, Schev. King's Lynn; of this scarce species I have captured four males and three females. They are fond of sunning themselves on leaves of Burdock, and other plants.

CRABRO GONAGER, Lep. King's Lynn, one male only in 1908.

ANTHOPHILA.

ANDRENA AMBIGUA, Perk. King's Lynn; male and female, Mr. C. G. Barrett. I have also taken several specimens.

,, DENTICULATA, Kirb. King's Lynn; of frequent occurrence at the flowers of *Calluna vulgaris* (Common Ling).

,, ARGENTATA, Sm. King's Lynn. Abundant but very local. There are large colonies in a few restricted spots, but at present I have failed to find *Nomada alboguttata* which is usually associated with it.

,, NIVEATA, Fries. King's Lynn, two specimens only.

NOMADA ROBERTJEOTIANA, Panz. King's Lynn. Usually considered a rare species, but I have taken a long series in July and August at the flowers of *Senecio jacobæa* (Common Ragwort). It is said to be parasitic on *Andrena analis*.

,, BIFIDA, Thoms. King's Lynn, not uncommon. Mr. E. Saunders also records its occurrence in Norfolk.

,, FABRICIANA, L. King's Lynn, scarce.

OSMIA LEUCOMELANA, Kirb. King's Lynn. Nine specimens at the flowers of *Lotus corniculatus*.

FURTHER NOTES ON SPECIES PREVIOUSLY RECORDED.

CHRYSIDIDÆ.

CLEPTES NITIDULUS, Fab. King's Lynn, scarce.

NOTOZUS PANZERI, Fab. Near Swaffham and King's Lynn, sometimes common.

FOSSORES.

TIPHIA FEMORATA, Fab.
,, MINUTA, V. d. Lind. } King's Lynn, a few taken.

PASSALŒCUS MONILICORNIS, Dahlb. King's Lynn, rare. This is probably the species recorded as *P. turionum*, Dahlb.

GORYTES TUMIDUS, Panz. King's Lynn, not common.

,, QUADRIFASCIATUS, Fab. King's Lynn, common.

MELLINUS SABULOSUS, Fab. King's Lynn, not common; it is fond of sunning itself on the leaves of *Tussilago farfara* (Coltsfoot).

CRABRO TIBIALIS, Fab. King's Lynn, scarce.

,, CLAVIPES, Linn. King's Lynn, scarce.

,, PODAGRICUS, V. d. Lind. King's Lynn, very common.

DIPLOPTERA.

ODYNERIS GRACILIS, Brullé. King's Lynn, not common.

ANTHOPHILA,

HALICTUS SUBFASCIATUS, Nyl. (*fulvicornis*, Kirb.). King's Lynn, not common.

ANDRENA PILIPES, Fab. King's Lynn, scarce.

,, CLARKELLA, Kirb. King's Lynn, locally abundant.

,, CETII, Schr. Hunstanton.

MACROPIS LABIATA, Fab. King's Lynn. I have taken a good series of both sexes of this very active species. It seems to be most partial to the flowers of *Lysimachia vulgaris*, but I have occasionally taken it at flowers of *Carduus* and *Lotus corniculatus*.

CILISSA LEPORINA, Panz. King's Lynn. Common.

DASYPODA HIRTIPES, Latr. King's Lynn; this beautiful species is abundant in one localtiy.

NOMADA FLAVOGUTTATA, Kirb. King's Lynn, two only.

CHELOSTOMA FLORISOMNE, Linn. King's Lynn, not common.

,, CAMPANULARUM, Kirb. King's Lynn, common.

MEGACHILE VERSICOLOR, Sm. King's Lynn, this is locally common at the flowers of *Lotus corniculatus*.

OSMIA SPINULOSA, Kirb. King's Lynn, four specimens.

SUPPLEMENTERY NOTES.

Mr. Bridgman's lists of *Hymenoptera Aculeata* are given in Vol. II., Part V., p. 617. Vol. III., Part III. p. 367. and Vol. IV., Part V., p. 690. A few species were added in Vol. VII., Part III., p. 428.

The following, which are treated as species by Mr. Bridgman, are now considered either as synonyms, varieties of other species, or as altered in appearance through being stylopized.

CRABRO LUTEIPALPIS, St. Farg. } =*C. elongatulus*. V. d. Lind.
,, OBLIQUUS, Shuck. }

ANDRENA DECORATA, Sm. } =*A. bimaculata*, Kirb. Second
,, VITREA, Sm. } brood.
,, BICOLOR, Fab. =*A. Gwynana*, Kirb. Second brood.
,, APRILINA, Sm. =*A. nigroænea*, Kirb. Stylopized.
,, PICICORNIS, Kirb. =*A. Trimmerana*, Kirb. Stylopized.
,, PARVULA, Kirb. =*A. minutula*, Kirb. Second brood.
,, COMBINATA, Kirb. } =*A. dorsata*, Kirb.
,, CONNECTENS, Kirb. }
,, CONVEXIUSCULA, Kirb. =*A. Afzeliella*, Kirb. Stylopized.
,, FUSCATA, Kirb. =*A. Afzeliella*, Kirk., var.

BOMBUS ELEGANS, Sm. =*B. Latreillelus*, Kirb., var
,, MUSCORUM, Sm. =*B. agrorum*, Fab.
,, SUBTERRANEUS, L. =*B. hortorum*, L., var.
,, LUCORUM, Sm. } =*B. terrestris*, L., vars.
,, VIRGINALIS, Kirb. }

XVIII.

FAUNA AND FLORA OF NORFOLK.

Additions to Part XII., Coleoptera (Fourth List).*

By James Edwards, F.E.S.

Read 30th March, 1909.

I have great pleasure in accepting the invitation of the Society to edit, once more, the records of Coleopterous insects found in the county which have come to hand during the past five years. The names of the recorders are given in each instance, and it will be seen how much we are indebted to the talent and industry of Mr. E. A. Atmore, F.E.S., of King's Lynn, for an account of the beetles found in that district.

Carabidæ.

Carabus nitens, L. On damp Heaths near King's Lynn, not uncommon (Atmore.)

Dyschirius salinus, Schaum. Holme-next-the-Sea, August, 1906 (Morley).

Læmostenus complanatus, Dj. One specimen near Norwich (Thouless).

Anchomenus atratus, Duft. I found a specimen, evidently of local origin, mixed with *A. viduus* in coll. Dossetor.

Amara anthobia, Villa. King's Lynn (Atmore); det. Crawshay.

,, patricia, Duft. Mousehold Heath (Thouless).

Acupalpus Gyllenhalli, Th. In wet moss, King's Lynn (Atmore).

,, exiguus, Dj. Locally common in wet moss near King's Lynn (Atmore).

* The lists to which the present is supplementary are to be found in these 'Transactions,' vol. v. p. 427, vol. vi. p. 515, and vol. vii. p. 744 respectively.

Dytiscidæ.

Hydroporus melanarius, Sturm. Ant district; Palling district (Balfour Browne).

,, discretus, Fairm. Stalham district, one specimen only (Balfour Browne).

Dytiscus circumcinctus, Ahr. Broads district, 1904 (Balfour Browne).

Graphoderes cinereus, L. Ant district, 1904 (Balfour Browne). A fen species formerly found in the counties of Cambridge and Huntingdon, but no captures have been recorded for very many years.

Hydrophilidæ.

Hydrobius oblongus, Hbst. Muck Fleet district, 1904 (Balfour Browne).

Helophorus porculus, Bedel. Yarmouth, September (Thouless).

,, æqualis, Th. Yarmouth, April, June (Thouless).

,, strigifrons, Th. Horning, June (Thouless).

,, laticollis, Th. Horning (Edwards).

Octhebius margipallens, Latr. Broads district, rare, (Balfour Browne).

,, viridis, Broads district, common (Balfour Browne).

Hydræna testacea, Curt. Ant, Hickling, Palling and Ormesby districts, 1904 (Balfour Browne).

,, palustris, Er. Ant district, 1904 (Balfour Browne).

,, Britteni. Ranworth (Champion).

Staphylinidæ.

Aleochara spadicea, Gr. King's Lynn, one in a sand-pit not far from a number of mole's nests (Atmore).

,, crassiuscula, Sahl. Yarmouth, May, 1908 (W. West).

Myrmedonia funesta, Gr. Common in ant's nests near King's Lynn (Atmore).

Bolitochara lucida, Gr. King's Lynn (Atmore).

Myllæna minuta, Gr. Broads district (Beare); by shaking cut reeds and marsh hay.

Megacronus cingulatus, Man. Near King's Lynn in sand-pits, scarce (Atmore).

Quedius fulgidus, Gr. King's Lynn, one large male running on a pathway, 18th April, 1909 (Atmore).

,, truncicola, Fairm. A large male dug out of a rotten beech stump at King's Lynn, May, 1908 (Atmore).

,, brevicornis, Th. From large fungus on elm near King's Lynn (Atmore).

,, nigrocœruleus, Fauv. Two specimens taken under carrion in a wooded district near King's Lynn (Atmore) det. Champion.

,, suturalis, Th. Also from fungus on elm at King's Lynn, rare (Atmore).

Leistotrophus murinus, L. Near King's Lynn (Atmore).

Philonthus splendens, F. Not uncommon in carrion, King's Lynn (Atmore).

Cafius sericeus, Holme. Near King's Lynn (Atmore).

Stenus Guynemeri, Duv. One from moss near King's Lynn (Atmore); det. Newbery.

,, declaratus, Er. King's Lynn, rather common in moss (Atmore).

Bledius pallipes, Gr. Cromer (Elliman).

Acidota cruentata, Man. Near King's Lynn, not rare at times in sand-pits in February (Atmore).

Silphidæ.

Agathidium nigripenne, F. King's Lynn, not common (Atmore).

Colenis dentipes, Gyll. Cromer (Elliman).

Cyrtusa pauxilla, Schmidt. Trowse, 23rd May, 1878 (Edwards).

Anisotoma cinnamomea, Pz. King's Lynn, one specimen flying beneath Spruce trees, May, 1908 (Atmore).

,, furva, Gr. Hunstanton, Sept., 1908, flying in numbers one still afternoon from 4.30 to 5 o'clock (Atmore).

CHOLEVA MORIO, F. Near King's Lynn, rare (Atmore).

HISTERIDÆ.

HISTER MARGINATUS, Er. King's Lynn (Atmore): one specimen picked up on the road, and two from a large brown fungus on elm.

PHALACRIDÆ.

PHALACRUS HYBRIDUS, Flach. Holkham (Edwards).

NITIDULIDÆ.

EPURÆA OBSOLETA, F. King's Lynn (Atmore).

,, PARVULA, Sturm. King's Lynn, rare (Atmore).

OMOSITA DEPRESSA, L. Near King's Lynn (Atmore).

SORONIA PUNCTATISSIMA, Ill. Dunston (Thouless).

COLYDIIDÆ.

CERYLON FAGI, Bris. Near King's Lynn (Atmore); det. Newbery.

CUCUJIDÆ.

SILVANUS MERCATOR. Well established in a bakery at King's Lynn (Atmore).

CRYPTOPHAGIDÆ.

CRYPTOPHAGUS SCANICUS, L. Common in large white boleti on birch at King's Lynn (Atmore).

LATHRIDIIDÆ.

MELANOPHTHALMA TRUNCATELLA, Man. Sherringham (or Wells), August, 1904 (Joy.)

COCCINELLIDÆ.

HYPERASPIS REPPENSIS, Hbst. Near King's Lynn, scarce (Atmore).

PLATYNASPIS LUTEORUBRA, Goeze. Not uncommon near King's Lynn (Atmore).

SCYMNUS LIMONII, Donist. Holme-next-the-Sea, August, 1906 (Morley).

Mycetophagidæ.

Triphyllus suturalis, F. King's Lynn, abundant in boleti on elm (Atmore).

Parnidæ.

Parnus luridus, Er. The commonest species of the genus throughout the county, hitherto confounded with *P. auriculatus*, Foure. (*prolifericornis*, F.). I recently called attention to its occurrence in this country (Ent. Mo. Mag., XLIV., p. 102). *P. auriculatus*, Fourc, I have only from a pond on Alderford common, whence I brought one example on 12th June, 1890.

,, anglicanus, Edw. Specimens of a Parnus which I got at Horning, in May, 1888, prove to belong to a distinct and undescribed species; Mr. Thouless met with the same species there in May, 1909.

Heteroceridæ.

Heterocerus fusculus, Kies. Wretham Heath, 24th August, 1905 (Edwards).

Scarabæidæ.

Geotrupes vernalis, L. Sometimes common in sand-pits near King's Lynn, but uncertain in appearance (Atmore); det. Newbery.

Anobiidæ.

Niptus crenatus, F. King's Lynn, one specimen (Atmore.)

Tenebrionidæ.

Alphitophagus 4-pustulatus, Steph. King's Lynn, in flood refuse (Atmore); det. Newbery.

Alphitobius piceus, Ol. King's Lynn in granaries (Atmore).

Helops pallidus, Curt. Hunstanton, not uncommon (Atmore).

Anthicidæ.

Anthicus instabilis, Schmdt. Near King's Lynn (Atmore).

CURCULIONIDÆ.

BARYPEITHES ARANEIFORMIS, Schrk. Common in moss and on roadsides at King's Lynn (Atmore).

PHYLLOBIUS GLAUCUS, Scop. King's Lynn, locally abundant on hazel, less frequent on birch (Atmore). Foxley (Thouless).

TROPIPHORUS ELEVATUS, Hbst. One specimen near King's Lynn (Atmore).

HYPERA RUMICIS, L. Near King's Lynn, not common (Atmore).

,, TRILINEATA, Marsh. Mousehold Heath, 19th July, 1886 (Edwards). King's Lynn, rare (Atmore).

ERIRHINUS TREMULÆ, Pk. King's Lynn, several from aspen (Atmore). Wretham Heath, 30th August, 1907, on white poplar (Edwards).

ANOPLUS ROBORIS, Suff. King's Lynn, one only (Atmore): det. Newbery.

TYCHIUS TOMENTOSUS, Hbst. Several specimens near King's Lynn (Atmore); det. Newbery.

CŒLIODES RUBICUNDUS, Pk. King's Lynn, moderately common on oaks (Atmore).

,, ERYTHROLEUCUS, Gmel. King's Lynn, common on birch (Atmore).

CEUTHORHYNCHUS LITURA, F. King's Lynn, apparently not common (Atmore).

,, PICITARSIS, Gyll. Cromer (Elliman).

CIONUS TUBERCULOSUS, Scop. Foxley (Thouless).

APION FUSCIROSTRE, F. King's Lynn, of frequent occurrence on broom (Atmore).

,, PUBESCENS, Kirby. King's Lynn, but not common (Atmore).

BAGOUS CLAUDICANS, Boh. Brandon (Thouless).

,, LIMOSUS, Gyll. Brandon (Thouless)

RHINOMACER ATTELABOIDES, F. King's Lynn, not uncommon by beating Scots' pine in bloom at the end of May (Atmore).

Scolytidæ.

Hylurgus piniperda, L. King's Lynn, common, causing much mischief to Scots' pines (Atmore).

Trypodendron domesticum, L. By beating old fir hedges, and occasionally found flying, near King's Lynn (Atmore).

Tomicus laricis, L. Near King's Lynn, not uncommon (Atmore).

Anthribidæ.

Brachytarsus varius, F. By beating Scot's pines near King's Lynn (Atmore). I find this species not uncommonly by beating Spruce trees infested with the Spruce-gall Aphis at Colesborne, Glos'.

Cerambycidæ.

Callidium alni, L. One example beaten from oak near King's Lynn, 1905 (Atmore).

Hylotrupes bajulus, L. Cromer (Lewcock).

Molorchus minor, L. Narborough (Thouless). Near King's Lynn, several from Scots' pine and hawthorn in bloom (Atmore)

,, minimus, Scop. Near King's Lynn, not so frequent as the last (Atmore.

Grammoptera analis, Pz. King's Lynn (Atmore).

Chrysomelidæ.

Donacia obscura, Gyll. Sutton Broad (Balfour Browne). Said by Donisthorpe to occur on *Carex rostrata*.

Cryptocephalus nigrocœruleus, Goeze. Occasionally on birch at King's Lynn (Atmore).

Mantura chrysanthemi, E. H. King's Lynn, not scarce at times in sand-pits (Atmore).

Apthona herbigrada, Curt. King's Lynn, a single specimen swept in 1899 (Atmore).

The following are additional records for rare or interesting species, and corrections of previous records :—

CICINDELIDÆ.

CICINDELA MARITIMA, Dj. Hunstanton (Atmore).

CARABIDÆ

LICINUS DEPRESSUS, Pk. King's Lynn, two examples (Atmore).

AMARA INFIMA, Duft. King's Lynn, sometimes common in sand-pits in early spring (Atmore).

DYTISCIDÆ.

HYDROPORUS HALENSIS, F. Palling district (Balfour Browne).

,, SCALESIANUS, Steph. Ant district; Bure district (Balfour Browne). A species not recorded for this county since its description by Stephens in 1828.

AGABUS ULIGINOSUS, L. Horsey district, a few specimens (Balfour Browne).

ILYBIUS SUBÆNEUS, Er. Hickling, several (Balfour Browne).

RHANTUS ADSPERSUS, F. Hickling district (Balfour Browne). This is a most important capture, as the species is not known to have occurred in Britain for something like seventy years.

HYDROPHILIDÆ.

HELOPHORUS ARVERNICUS, Muls. Must be expunged from our list; my record of it is an error, founded on a large and strongly marked specimen of *griseus*, Hbst., determined for me many years ago by the late T. P. Dossetor.

HELOPHORUS DORSALIS, Marsh. (*mulsanti*, Rye). A submaritime species found not uncommonly at Cley, &c. Hickling, one example (Balfour Browne). My record of this species from Wretham Heath (antea, Vol. v., p. 448) is an error founded on an exceptionally large and well marked example of *H. affinis*, Marsh.

,, AFFINIS, Marsh. Only from Wretham Heath.

HELOPHORUS GRANULARIS, L. (*brevicollis*, Thoms). Must also be omitted from our list (cf. my revision of the British species of this genus Ent. Mo. Mag., XLIV., pp. 218-224).

,, VIRIDICOLLIS, Steph. This name should be used instead of *æneipennis*, Thoms.

,, 4-SIGNATUS, Bach. This is the name by which the "*dorsalis*, Marsh" of English authors should be known.

STAPHYLINIDÆ.

CALODERA ÆTHIOPS, Gr. King's Lynn, in wet moss, April, 1909 (Atmore).

MYRMEDONIA COLLARIS, Pk. King's Lynn, two examples (Atmore).

HOMALOTA LITTOREA, Shp. Weybourne, 19th September, 1908 (Edwards).

GYMNUSA BREVICOLLIS, Pk. King's Lynn, not rare in wet *Sphagnum* (Atmore).

MYCETOPORUS REYI, Pand. } King's Lynn, occasionally
,, CLAVICORNIS, Steph. } in sand-pits (Atmore).

,, LEPIDUS, Gr. King's Lynn, April, 1909 (Atmore).

PHILONTHUS MARGINATUS, F. King's Lynn, locally abundant in wet moss (Atmore).

,, NIGRITA, Nord. King's Lynn, a few specimens in moss (Atmore).

SILPHIDÆ.

SILPHA LÆVIGATA, F. Hunstanton, occasionally (Atmore).

HISTERIDÆ.

HISTER MERDARIUS, E. H. King's Lynn, one from fungus on elm (Atmore).

DENDROPHILUS PUNCTATUS, Hbst. King's Lynn (Atmore).

NITIDULIDÆ.

NITIDULA RUFIPES, L. King's Lynn (Atmore).

COLYDIIDÆ.

SARROTRIUM CLAVICORNE, L. King's Lynn, several specimens in sand-pits (Atmore).

CUCUJIDÆ.

NAUSIBIUS DENTATUS, Marsh. King's Lynn, occasionally in large white fungi on birch (Atmore).

LÆMOPHLŒUS FERRUGINEUS, Steph. Costessey, June, 1908 (Thouless).

CRYPTOPHAGIDÆ.

ANTHEROPHAGUS NIGRICORNIS, F. King's Lynn (Atmore).

MYCETOPHAGIDÆ.

MYCETOPHAGUS MULTIPUNCTATUS, Hell. King's Lynn, in fungi on birch (Atmore).

TRIPHYLLUS PUNCTATUS, F. King's Lynn, in large brown fungi on elm (Atmore).

BYRRHIDÆ.

CYTILUS VARIUS, F. King's Lynn, frequent in moss (Atmore)

SCARABÆIDÆ.

ODONTÆUS MOBILICORNIS, F. Near Swaffham, one female taken flying about 6 p.m. (Atmore). Downham, July 13th, 1904 (R. S. Smith.)

GEOTRUPES TYPHÆUS, L. Near King's Lynn, common on sandy heaths (Atmore).

HOPLIA PHILANTHUS, Sulz. King's Lynn (Atmore).

ANOMALA FRISCHI, F. Hunstanton: also near King's Lynn in sandy spots, including several of the rare variety with green elytra (Atmore).

CETONIA AURATA, L. "Has occurred at Downham Market, but not recently" (Atmore).

BUPRESTIDÆ.

AGRILUS ANGUSTULUS, Ill. King's Lynn, not common (Atmore).

ELATERIDÆ.

ELATER BALTEATUS, L. King's Lynn, on birch and Scot's pine near birches (Atmore).

CARDIAPHORUS ASELLUS, Er. "Near King's Lynn, under stones and sometimes flying in numbers on nearly bare sandy spots on the heaths. I once saw the species assembling in such a place, and took dozens of specimens in the space of a square yard" (Atmore).

ATHOUS VITTATUS, Fab. Foxley (Thouless).

LIMONIUS CYLINDRICUS, Pk. King's Lynn, frequent on birch (Atmore).

CORYMBITES TESSELLATUS, L. Near King's Lynn (Atmore).

,, QUERCUS, Gyll. King's Lynn (Atmore).

,, ÆNEUS, L. King's Lynn, under stones on heaths (Atmore).

DASCILLIDÆ.

DASCILLUS CERVINUS, L. King's Lynn, occasionally (Atmore)

PRIONOCYPHON SERRATICORNIS, Müll. Lakenham, August 22nd, 1904 (Thouless).

TELEPHORIDÆ.

TELEPHORUS LITURATUS, F. King's Lynn, common (Atmore).

,, HÆMORROIDALIS, F. King's Lynn, occasionally (Atmore).

,, LATERALIS, L.
,, THORACICUS, Gyll. } King's Lynn, scarce (Atmore).

,, FUSCICORNIS, Ol. King's Lynn, one or two annually (Atmore).

MALACHIUS BARNEVILLEI, Puton. This is the correct name for the insect taken by Mr. Thouless on the flowers of *Convolvulus arvensis* at Hunstanton on 21st June, 1899, and 26th June, 1906, and recorded as *M. viridis*, F. Hunstanton, 30th June, 1907 (Atmore).

SILIS RUFICOLLIS, F.
ANTHOCOMUS SANGUINOLENTUS, F. } Near King's Lynn, on fen-land (Atmore)

,, TERMINATUS, Mén. Common at Sutton (Beare).

CLERIDÆ.

CLERUS FORMICARIUS, L. King's Lynn, two examples under bark (Atmore).

ANOBIIDÆ.

DRYOPHILUS PUSILLUS, Gyll. King's Lynn, sometimes common on spruce (Atmore).

ERNOBIUS MOLLIS, L. King's Lynn, not uncommon (Atmore).

LYCTUS CANALICULATUS, F. King's Lynn, abundant in an old post (Atmore).

TENEBRIONIDÆ.

SCAPHIDEMA ÆNEUM, Pk. King's Lynn, occasionally under old logs (Atmore).

HELOPS STRIATUS, Fourc. Near King's Lynn, very abundant under the dead bark of Scots' pine (Atmore).

MELANDRYIDÆ.

TETRATOMA FUNGORUM, F. King's Lynn, very common in and on large white *Polypori* on birch (Atmore).

CONOPALPUS TESTACEUS, Ol. King's Lynn, one example (Atmore.)

RHIPIDOPHORIDÆ.

METŒCUS PARADOXUS, L. Near King's Lynn, occasionally beaten or swept (Atmore).

ŒDEMERDÆ

ŒDEMERA VIVESCENS, L. On the 5th June, 1906, Mr. Thouless was fortunate enough to discover the actual habitat of this species in the flowers of *Stellaria holostea*, in its original and only British locality.

CURCULIONIDÆ.

TRACHYPHLŒUS SPINIMANUS, Germ. Hunstanton (Thouless).

BARYNOTUS OBSCURUS, F. King's Lynn, sometimes common (Atmore).

GRONOPS LUNATUS, F. King's Lynn, not common (Atmore).

ALOPHUS TRIGUTTATUS, F. King's Lynn, scarce (Atmore).

HYPERA FASCICULATA, Hbst. King's Lynn, not uncommon under *Erodium cicutarium* in sandy places (Atmore).

,, POLYGONI, L. King's Lynn, scarce (Atmore).

HYLOBIUS ABIETIS, L. Near King's Lynn, specimens occur annually (Atmore).

GRYPIDIUS EQUISETI, F. King's Lynn, not common (Atmore).

ERIRHINUS NEREIS, Pk. King's Lynn, common (Atmore). My remarks on this species (under *E. festucæ*) *antea*, Vol. V., p. 488, were due to defective appreciation of its distinctive characters; I have since found that my only Norfolk specimens of *E. nereis* are two taken at Brundall in 1883 on 11th May and 28th June respectively.

,, SALICINUS, Gyll. King's Lynn, on sallows, very local but common where it occurs (Atmore).

,, TORTRIX, L. King's Lynn (Atmore).

BALANINUS CERASORUM, Hbst. King's Lynn, six examples, mostly beaten from alder (Atmore).

,, RUBIDUS, Gyll. King's Lynn, frequent on birch (Atmore).

ELLESCHUS BIPUNCTATUS, L. King's Lynn, in some years not uncommon on sallows (Atmore.)

ACALLES TURBATUS, Boh. King's Lynn, common in sand-pits (Atmore).

CRYPTORHYNCHUS LAPATHI, L. King's Lynn. common on old sallows (Atmore).

CEUTHORHYNCHIDIUS TERMINATUS, Hbst. One example, Weybourne, 19th September, 1908 (Edwards).

AMALUS SCORTILLUM, Hbst. King's Lynn, local (Atmore).

RHYNCHITES NANUS, Pk. } Near King's Lynn, common on
,, UNCINATUS, Th. } birch (Atmore).

HYLASTES PALLIATUS, Gyll. King's Lynn (Atmore).

BRUCHIDÆ.

BRUCHUS CISTI, Fab. Hunstanton (Thouless).

CERAMBYCIDÆ.

CALLIDIUM VIOLACEUM, L. King's Lynn. occasionally: Downham Market, abundant (Atmore).

GRACILIA MINUTA, F. King's Lynn. common in warehouses (Atmore).

Monohammus sartor, F. King's Lynn, one example, August, 1903 (Atmore).

,, sutor, L. King's Lynn, picked up in the street, one in July, 1898, and one in July, 1902 (Atmore).

Astynomus ædilis, L. King's Lynn, August, one in 1902 and one in 1904 (Atmore).

Liopus nebulosus, L.
Pogonocherus hispidus, L. } King's Lynn (Atmore).
,, dentatus, Foure.

Polyopsia præusta, L. King's Lynn, common (Atmore).

Phytœcia cylindrica, L. King's Lynn, one example swept from a hedge-bank, 6th June, 1906 (Atmore).

Chrysomelidæ.

Donacia dentata, Hoppe. Near King's Lynn, sometimes abundant (Atmore).

,, cinerea, Hbst. King's Lynn, rare (Atmore).

,, affinis, Kunze. King's Lynn (Atmore).

Hæmonia curtisi, Lac. King's Lynn, several times in brackish pits (Atmore).

Lamprosoma concolor, Sturm. King's Lynn, not common (Atmore).

Cryptocephalus fulvus, Goeze. } King's Lynn, not uncom-
,, pusillus, F. } mon (Atmore).

Chrysomela gœttingensis, L. King's Lynn, several specimens crawling on roadways (Atmore).

,, oricalcia, Müll. Near Swaffham, not common (Atmore).

Phyllobrotica quadrimaculata, L. King's Lynn, not uncommon on *Scutellaria galericulata* (Atmore).

Mantura rustica, L. } King's Lynn, occasionally
Thyamis holsatica, L. } (Atmore).

,, castanea, Duft. King's Lynn, sometimes abundant (Atmore).

Psylliodes chalcomera, Ill. } King's Lynn, occasionally
,, chrysocephala, L. } (Atmore).

Apteropeda globosa, Pz. King's Lynn, frequent (Atmore).

XIX.

FAUNA AND FLORA OF NORFOLK.

Additions to Part VIII., Hemiptera (Sixth List).*

By James Edwards, F.E.S.

Read 30th March, 1909.

The seven species of Hemiptera enumerated below are the only additional ones which have come to my knowledge as occurring in this county subsequent to my list of 1904 (vol. vii. p. 746).

Bythoscopina.

Idiocerus cognatus, Fieb. Wretham Heath, 30th August, 1907, on a young tree of *Populus alba*, which had evidently been planted. Mr. Thouless has also met with it on the same food-plant in gardens on College Road, Norwich.

,, elegans, Flor. Keswick Common, 25th August, 1907, one female only, on a narrow-leaved *Salix*. At Colesborne, Glos., this species is not uncommon on sallows.

Acocephalaria.

Acocephalus æstuarinus. Edw. I had already (Hem. Hom. Brit. Isl., p. 120) referred to this insect in dealing with *A. nervosus*, but I took advantage of an excursion to the salt-marshes east of Wells on the 28th August, 1907, to study it once more in the field and collect ample material. I became convinced that, although one may reasonably suppose the characters which distinguish it from *A. nervosus* to have been

*The previous lists have appeared in these 'Transactions,' as follows:—Vol. iii., p. 700; vol. iv., p. 702; vol. v., p. 650: vol. vi., p. 524; and vol. vii., p. 746.

acquired as the result of its sub-maritime environment, it is now quite sufficiently distinct to be considered a separate species. I may add that Dr. L. Melichar of Vienna, an authority on European Cicadina to whom I sent specimens, is of the same opinion. It is usually found on the ground beneath the herbage, but I beat imagines of both sexes as well as empty nymph-skins from *Suæda fruticosa*.

ACOCEPHALUS LIMICOLA, Edw. Salt-marshes, Hunstanton, 30th July, 1886, Wells, 28th August, 1907. This species bears the same relation to *A. albifrons*, that the preceding does to *A. nervosus*.

JASSARIA.

DELTOCEPHALUS CORONIFER, Marsh. Wretham Heath, on the dry sandy banks of Ringmere, 24th August, 1905 (Edwards).

TYPHLOCYBINA.

TYPHLOCYBA FRUSTRATOR, Edw. Arminghall, off elm, 6th October, 1889; Foxley Wood, 10th October, 1890; Howe Grove, 10th September, 1891 (Edwards).

.. CANDIDULA, Kbm. Occurred at the same time and place as *Idiocerus cognatus* (*supra*). It has also been found in the London district.

The following notices refer to species already recorded for the county:—

TINGIDINA.

SERENTHIA LÆTA, Fall. Weybourne, 19th September, 1908. (Edwards).

SALDIDÆ.

SALDA LATERALIS, Fall. Weybourne, 19th September, 1908, both sexes abundant: the only Salda seen (Edwards).

CAPSIDÆ.

ORTHOTYLUS RUBIDUS, Fieb. Weybourne, 19th September, 1908, two examples of the red form; I did not see any of the green form.

PLAGIOGNATHUS ALBIPENNIS, Fall. Weybourne, 19th September, 1908 (Edwards); both sexes not uncommon on *Artemisia maritima*.

,, PULICARIUS, Fall. By Ringmere, Wretham Heath, 24th August, 1905 (Edwards).

BYTHOSCOPINA.

MACROPSIS RUBI, Boh. (*olim gen. Pediopsis*). Abundant on brambles near Norwich; formerly included under the name *scutellata*, Boh., a species which lives on sallows.

,, GLANDACEA, Fieb., (*ulmi* Scott). Occurred freely in its old locality at Eaton, 25th August, 1907 (Edwards).

,, VIRESCENS, Fab. On the 25th August, 1907, I got from a tree of *Salix alba* at Eaton, several specimens of the form with a black spot in the middle of the forehead (*graminea*, Fab.). All were females and the proportion proved to be about one-third of the total number taken. I had previously met with but one example of this form, at Lakenham, many years ago.

IDIOCERUS VARIUS, Germ. I was very pleased to find this species not uncommon on a narrow-leaved *Salix* at Keswick Common on the 25th August, 1907, the more so as its old locality at Whitlingham had long since been destroyed.

,, VIDUATUS, Edw. In his catalogue of the Homoptera of the Government of St. Petersburg (1907), Prof. Oshanin records the capture of a female of this species between Shuvaleff and Udalno on 16th September, 1895; but I am not acquainted with any other record of the species.

Jassaria.

Paramesus phragmitis, Boh. Roydon Fen, 21st September, 1908 (Edwards).

Deltocephalus socialis, Flor. Sandy banks of Ringmere, Wretham Heath, 30th August, 1907 (Edwards).

,, maculiceps, Boh. Rather freely, but females only, at Roydon Fen, 21st September, 1908 (Edwards).

Thamnotettix attenuatus, Germ. I was rather surprised to meet with this species at the last-named locality, having previously found it on Mousehold Heath only.

Typhlocybina.

Dicraneura similis, Edw. Roydon Fen, 21st September, 1908 (Edwards).

Delphacina.

Stenocranus fuscovittatus, Stäl. (*olim gen. Liburnia*). One male, with the species last-named.

Kelisia pallidula, Boh., (*olim gen. Liburnia*). With the last-named, not uncommon.

Delphax signoreti, Scott. (*olim gen. Liburnia*). One female at Brundall, 31st August, 1907 (Edwards).

Psyllidæ.

Aphalara pilosa, Oshn. This is the species previously recorded as *A. artemisiæ*, Först. The latter insect, which is distinguished from *A. pilosa* by the absence of sub-erect hairs on the elytra, and of which I have seen undoubted examples from the Isle of Portland, lives on *Artemisia absinthium* and *A. campestris*. I found the latter plant as a roadside weed just outside the town of Thetford in August, 1888; but, though I was in search of *Eupteryx artemisiæ*, Kbm., of which it is the food plant, it did not produce a single insect of any kind.

XX.

FAUNA AND FLORA OF NORFOLK.

Additions to Part IV., Fishes (Sixth List).†

By A. H. Patterson.

Read 30th March, 1909.

Those marked with a * are new to the County List.

The following additions to the list of the more notable Norfolk Fishes, I regret, do not include so many new species as, perhaps, characterised two or three of those preceding it; I have exercised quite as much watchfulness, but with the exception of the year 1907, from atmospheric and kindred conditions proving disadvantageous, indeed almost disastrous, my shrimper friends fell in with very few rare or interesting fishes. My best find has certainly been *Scomber thunnina*, in July, 1906, a species hitherto unrecorded for the British seas. I feel convinced that diligent search in other parts of the County, more especially in the neighbourhood of Lynn and Wells, and between Yarmouth and Lowestoft, would be the means of adding still fresh species to our Fish Fauna, and I shall be pleased to receive reports of rare species for the above list; or to examine doubtful examples, that may come in the way of members of the Society in the time to come.

Rose Perch (*Scorpæna dactyloptera*).

An example of this species, 7½ inches long, was taken in a shrimp-net, June 8th, 1905.

* Black Sea Bream (*Cantharus lineatus*).

From the neighbourhood of Cromer Knowle I received on

† For previous lists see vols. i., 1873-4., p. 21; iii., p. 677; v., 634; and vi., p. 495.

January 23rd, 1908, a 14-inch fish of this species; it had hitherto been unrecorded for the county. Subsequently I saw three or four others which were taken somewhere about the same time, indeed the trawlers then fishing in that neighbourhood seem to have fallen in with this hitherto unrecognised local species in some numbers.

* Four-Horned Cottus (*Cottus quadricornis*).

Among a consignment of Sprats taken south of Lowestoft, I obtained, on March 3rd, 1907, three adult specimens of this fish. Length 8½ inches. I was fortunate in seeing another, somewhere about the same time, taken on a line off the Britannia Pier.

Bubalis (*Cottus bubalis*).

A small example, length 2¾ inches, taken in a shrimp-net, April 26th, 1906. Another May 12th; I believe this to be less uncommon than is suspected.

* Scomber Thunnina.

Of this new British *Scomber* I was fortunate in obtaining a very fresh example on July 10th, 1906. It was taken by a local fishing-boat off Yarmouth. Length 2 feet, weight 7 lbs.; is now in the Tollhouse Museum, Yarmouth. The South Kensington authorities, to whom this fish was submitted, were good enough to determine the species for me.

Rock Goby (*Gobius niger*).

Two brought me by a shrimper in April, 1904. It would be well if naturalists living near the coast would look out for the Giant Goby (*Gobius capito*, Cuv.), which greatly resembles the present species. Couch's figure of the Black or Rock Goby was more than probably drawn from the larger species. (Vide *Zoologist*, 1903, plate viii., p. 429.]

White Goby (*Latrunculus pellucidus*).

One on Breydon, June, 1906.

Ballan Wrasse (*Labrus maculatus*).

Small examples numerously taken in shrimp-nets March, 1905. Most were of the green variety.

* Jago's Goldsinny (*Ctenolabrus rupestris*).

Freshly taken specimen brought in by a shrimper, June

5th, 1906. In June, 1907, no less than three, all 3 inches in length, came into my hands.

LESSER FORKBEARD (*Raniceps trifurcatus*).

I am inclined to think this species is often mistaken for *Liparis*, which when young it somewhat resembles. Length of this, and subsequent examples, $3\frac{1}{2}$ inches.

HYBRID TURBOT-BRILL.

June 7th, 1904; one measuring $14\frac{1}{2}$ inches; weight 24 ozs. One or two since. Not so rare as I had suspected.

MULLER'S TOPNOT (*Zeugopterus punctatus*).

One off Cromer Knowle, February 10th, 1908. Length $6\frac{1}{2}$ inches.

* MEGRIM (*Arnoglossus laterna*).

A $4\frac{1}{2}$ inch Megrim was taken on the roadstead by a shrimper, April 30th, 1906. Another on July 30th.

LEMON SOLE (*Solea lascaris*).

Mr. Robert Beazor, fish-merchant, sent me a very beautiful 10 inch specimen on August 8th, 1906.

SALMON-TROUT (*Salmo trutta*).

A remarkable incursion of this species into local waters, July, 1906. Mr. Robert Beazor had on sale no less than 1000 lbs. One example weighed $16\frac{1}{4}$ lbs., several others 12 lbs. One taken on a hook off Britannia Pier, October 28th, 1908, weight $3\frac{1}{2}$ lbs., and another smaller one on the same date.

CRUCIAN CARP (*Cyprinus carassius*).

This species swarms in a shallow horse-pond near the *Maids Head Inn*, Lound (midway between Yarmouth and Lowestoft). On July 30, 1908, I caught from the roadside a dozen, running to four inches in length. They have grown remarkably since, in an aquarium.

ANCHOVY (*Engraulis encrasicholus*).

A much injured example taken in a herring-net on October 23rd, 1906. Adult.

SUNFISH (*Orthagoriscus mola*).

A small example taken in a herring-net, October, 1905; was sold on the fish wharf, and sent away before I managed to see it.

Torpedo Ray (*Torpedo vulgaris*).

A very fresh example brought to me from Lowestoft, February 9th, 1907, which could not long have been taken out of the water.

Starry Ray (*Raia radiata*).

One the size of a dinner plate brought me by the same person, from Lowestoft, February 20th, 1907.

Among the rarer *Breydon* fishes I noticed the following species: a Garfish, October 20th, 1907; Piked Dogfishes, numerously, on November 14th, 1907; a Greater Weever, July 7th, 1907; a Scad, November 8th, 1905, a Mackerel, February 6th, 1907; Herring Syle was most abundant August of 1906 and 1907, but exceedingly scarce August, 1908.

XXI.

FAUNA AND FLORA OF NORFOLK.

Additions to Part XI., Birds (Fifth List)*.

By J. H. Gurney, F.L.S., and T. Southwell, F.Z.S.

Read March, 1908.

The following are the more important Ornithological occurrences in Norfolk since our last list, to the close of the year 1903.

White-tailed Eagle.

An adult female of this species, the first example in that stage of plumage which has been recorded in this county, was killed at Hanworth on 18th June, 1905.

† * Desert Wheatear (*Saxicola deserti*, Ruppell).

The first example of this species killed in Norfolk was met with on 31st October, 1907: now in the Connop Collection.

* For previous lists see volumes iv. 259 and 397, v. 642, vi. 501, and vii. 733. Those species marked with a * are new to the County and those with a † were seen by one or both the recorders.

* Eastern Stonechat (*Pratincola maura*).

An example was shot by Mr. G. F. Arnold at Cley on 2nd September, 1904 ('Zool.' 1905, p. 466).

Barred Warbler.

An immature example was obtained at Cley by Mr. Arnold, on September 11th, 1908, and a second the following day at Wells.

Yellow-browed Warbler (*Phylloscopus superciliosus* Gmelin).

First killed at Cley on 1st October, 1894, a second example at the same place on 29th October, 1907, and three more September 23rd and 24th, 1908.

Aquatic Warbler.

An example reported in the 'Field,' as killed in Norfolk on September 15th, 1904. Two others had previously been met with in Norfolk, the bird figured in Hunt's 'British Ornithology,' as a Sedge Warbler being of this species, also one shot at Blakeney on September 8th, 1896.

† Blue-headed Wagtail (*M. flava flava*).

An example in the Connop Collection killed on 3rd May, 1908.

Richard's Pipit.

A flock of these birds visited the Norfolk coast about the middle of October, 1907, and several were killed in that month and November. Also two others in October and November, 1908.

† * Water Pipit (*Anthus spipoletta*. Lin.).

An example identified by Mr. Howard Saunders and J. H. G., was killed in Norfolk on 25th January, 1905.

[* Citril Finch.

An adult ♂ taken by a Yarmouth bird-catcher 29th January, 1904. May have been an escaped one.]

Red-breasted Fly-catcher.

About a dozen of these birds have been obtained in Norfolk; they occur generally during the Autumn migration in September and October. They have all been in immature plumage, except one fine adult on September 24th, 1908.

ORTOLAN BUNTING.

A male entangled in some netting at Yarmouth 5th May, 1906.

† * YELLOW-BREASTED BUNTING (*Emberiza aureola*).

Mr. E. C. Arnold killed an example of this bird at Blakeney on 21st September, 1905; a second, an immature male, was killed near Wells, on September 5th, 1907.

* LITTLE BUNTING (*Emberiza pusilla*).

An adult female sent to Mr. H. F. Witherby from Cley, where it was shot on October 19th, 1908.

HOOPOE.

One seen at North Walsham by Rev. M. C. H. Bird on 24th March, 1904: another at Holkham on 14th April, 1906; a third by Mr. Walter Rye at Buxton on May 4th, 1907, and a fourth at Sidestrand on September 6th, 1908.

SNOWY OWL.

An example trapped at Cockley Cley near Swaffham in April, 1905.

PURPLE HERON.

An immature male shot on Breydon on the 8th August, 1906. Another picked up in a suburb of Lowestoft, October 9th, 1907, is now in Norwich Museum.

BITTERN.

The Bittern was heard "booming" at Catfield by Rev. M. C. H. Bird on 13th November, 1905, and again by Nudd at Hickling on 3rd March, 1906.

Mr. Bird also informs us that it was again heard on the Broad on March 23rd, April 12th, and October 1st, 1908.

WHITE STORK.

One of these birds was seen by Mr. Patterson on Breydon on 2nd July, 1905.

GLOSSY IBIS.

Four were seen on Breydon, 3rd September, 1906.

SPOONBILLS.

These birds visited Breydon on migration each year as usual. In the month of May and early in June, 1904, they were unusually numerous, as many as thirteen were seen together, one as late as July 8th, and a few as late as June, 1905.

In 1908 one, probably a wounded bird, was killed on November 21st.

* Black Brent (*Bernicla nigricans*).

On the authority of Mr. F. Coburn of Birmingham an adult male of this American species was shot near Lynn by a wildfowler named Richardson, and a second example, an adult female, by the same person on 15th January, 1907. A photograph of the latter specimen appeared in the 'Zoologist' for April, 1908, p. 21.

† Red-crested Pochard.

A flock of thirteen of these birds visited Breydon on September 4th, 1906; all are believed to have been killed between that date and 12th September. A male was also killed, Potter Heigham, on 23rd October, 1906.

Nyroca Duck (*Fulgula nyroca*).

In January, 1906, two of these birds were killed in Norfolk, four others in April and one in May. A flock of five was also seen by Rev. M. C. H. Bird on Hickling Broad on 27th December, 1907.

Pallas's Sand Grouse.

A flock of about twenty of these birds is said to have been seen in the Broad district on 11th June, and ten supposed to have belonged to the same flock at Somerton on 17th June, 1906. None were killed, but the observers in both cases were familiar with the appearance of these birds in 1888. In 1908 two were seen on Brancaster golf-links on June 28th, and a flock about the end of May at Blakeney.

Crane.

An immature Crane frequented the Marram hills about Ormesby and Caister for some three weeks until 13th April, 1906. It is believed to have departed unharmed.

Avocet.

One of these birds was seen on Breydon on 4th May, 1904, two others on the 11th, which stayed till the 15th of the month. Nine were seen also on Breydon from 14th to the 17th June, 1905. All these passed on unharmed. In 1908 one visited Breydon on June 28th, and a small flock appeared at Blakeney during the summer.

BLACK-WINGED STILT.

One seen by Rev. M. C. H. Bird on the Broad 28th May, 1905, another is reported in the same locality on 29th April, 1906. A third was reported to Mr. Bird on April 29th, 1908,

REEVE.

A nest with four eggs was found on one of the Broads 13th June, 1907.

* BAIRD'S SANDPIPER (*Tringa bairdi*).

Was shot at Hunstanton, September 16th, 1903, and identified while still in the flesh by Mr. M. J. Nicoll; it is now in Sir Vauncey Crewe's Collection.

† * MEDITERRANEAN SHEARWATER (*Puffinus yelkouanus*).

Two of these birds were killed at Cley, both males, in September, 1891, at the time they were recorded as Manx Shearwaters.

In addition to the birds mentioned in the above list many others worthy of mention have occurred during the past five years, the bulk of them at the period of spring or autumn migration; amongst them may be noted Black Redstarts, Pied Fly-catchers, Fire-crested Wren at Yarmouth in October, 1907; Rose-coloured Pastor; Blue-throats; one Dartford Warbler, a rare bird in Norfolk; a Nutcracker, near Lowestoft; Lapland Buntings; an occasional Gadwall, rare in East Norfolk; Velvet Scoters; Little Gulls; and Black Terns.

The Garganey Teal has been more frequent of late and the Bearded Tit fairly holds its own in its restricted habitat. A Reeve, so late as the summer of 1907, once more utilised the ancient cradle of its race, and in each of the years 1900, 1901, 1904, 1905, and three times in 1908, the Bittern was heard "to shake the sounding marsh" with its breeding note; all this is indicative of what might happen were the Wild Birds Protection Acts strictly enforced.

In the last supplement to our list, to the end of 1903 we were able to claim 309 species as having occurred in Norfolk; we are now able to add *eight* other species (marked in the above list with a *) thereby increasing the number to 317.

MISCELLANEOUS NOTES AND OBSERVATIONS.

WILD BIRD PROTECTION ON THE NORFOLK COAST.

The Reports from the four Societies for the Protection of the Wild Birds frequenting the Norfolk coast at the breeding season of 1908 are again exceedingly satisfactory, with the single exception of, perhaps, the most important of all—that of Breydon Water, one of the most favoured resorts of aquatic birds on the whole British coast, which, alas! is languishing for lack of funds.

Wolferton.—From this ancient breeding-place of shore birds, where the Society is under the patronage of H.M. the King, Mr. George Cresswell, the Hon. Secretary, reports that the number of breeding birds was well maintained, and of some species there was a decided increase. On the 8th April there were already several nests of Lapwings and Ring Plovers; the first Lesser Tern's eggs were found on 13th May, the first Common Tern's on the 16th. Nestlings of both species were observed on 4th of June. The number of Sheld-ducks showed a considerable increase.

Blakeney and Cley.—The Report from this resort is very favourable both as to the numbers of the various species and as to the extent of ground occupied by them; the nesting of the Oyster-catchers is also a very encouraging feature.

The following entries, extracted from the Watcher's diary, are of especial interest.

> Oyster-catcher.—On May 9th, a nest with eggs was found; June 6th, four strong young ones were seen. On July 18th, six of these birds were seen, two old and four young.

LESSER TERNS.—First nests with eggs were found on May 18th; by the 22nd they were nesting freely. The first young appeared on June 6th; by the 16th both species of Tern were hatching freely, and on the 1st July the young of the Lesser Tern were strong fliers.

COMMON TERN.—First egg on May 18th; first eggs hatched June 11th. Several good fliers on 16th July.

RING DOTTEREL.—There were nests with eggs on 18th May. On 1st June four young ones were hatched.

The following birds were also seen: Sandwich Terns, on May 27th and June 27th; Black Terns, a young bird on 4th August and an adult on 22nd. Later on in the autumn migration, many rare Warblers were observed.

Mr. Quinton Gurney of the Bank, Norwich, is the Hon. Secretary, and the entire amount at his disposal for this good work was only £9.

WELLS.—From this favoured locality comes the good news that the Earl of Leicester has undertaken the future protection of the Wild Birds himself, and under his care they will be as effectually watched as in the past.

The late Hon. Secretary, Mr. C. A. Hamond of Twyford Hall, gives in his Report the following account of the origin and progress of the Society:—

"To review shortly the proceedings of the Wells Society. In 1887 Messrs. J. H. Gurney and T. Southwell reported (Norf. Nat. Soc. Trans., vol. iv., p. 430) that Common and Lesser Terns, Ring Plovers, Redshanks and Sheld-ducks were decreasing in numbers as resident breeding species. In 1890, Col. Feilden, with the approval and support of the late Lord Leicester, formed a Society to enforce the Bye-Laws passed by the Norfolk County Council, and put on a watcher. The following year there were a considerable number of eggs. One season the experiment was tried of withdrawing the watcher, but most of the eggs were taken or destroyed.

Since then the watcher has been on duty each year, with the result that in 1908, as early as May 28th, about 900 Common Terns' eggs were counted, and probably between 400 and 500 pairs nested."

The watcher's diary gives the following information as to the nesting of the birds which appeared in great numbers, and the return of the Black-headed Gulls to their old nesting site in Mow Creek after an absence of 70 years is of especial interest.

Ring Plovers' and Redshanks' nests with eggs were found on 18th May when the watcher went on duty, and the first hatching of the latter took place on the 23rd of that month. The first Lesser Terns' nest was seen on the 19th May, and that of the Common Tern on the 20th. On the 28th May the watcher counted 896 Common Terns' eggs. Young Lesser Terns were seen on 10th June, and Common Terns on the 11th. A Roseate Tern was seen on 19th June and young Sheld-ducks on the 27th. A Sandwich Tern and a party of six Black Terns were seen on 25th July. The watcher reports that he found eleven nests of the Black-headed Gull, but that " there were more birds scattered about."

It is a matter for great satisfaction that the fate of this interesting nesting site is placed beyond the risk of casual subscriptions by the beneficent act of the Earl of Leicester.

Breydon Society.—No details of the work of this important Society are given in the Report, but it is known that the presence of a watcher on the water has had most beneficial results, and it is with extreme regret that we read as follows: "It is obvious that without further subscriptions it will be impossible to continue the watching of Breydon during the whole of the present close time, and it need scarcely be mentioned how disastrous it would be if the watcher has to be withdrawn during August, even if not before then." The due protection of Breydon is a matter of more than local interest, and an appeal for help to Naturalists beyond the immediate neighbourhood surely would meet with a favourable response. No extracts are given in the Report from the watcher's diary, which is much

to be regretted, as it would then be seen how good a work the Society is doing. The Hon. Secretary is Mr. Henry P. Frederick, South Quay, Great Yarmouth.—T. S.

Estuarine Shells from Ludham.—On 28th April, 1908, I sent for exhibition at the Meeting specimens of shells found in mud dredged out of the River Ant near Ludham Bridge in the summer of 1906. This mud was found to contain immense quantities of Molluscan shells of all sizes belonging to the species *Scrobicularia piperata*, *Cardium edule* and *Tellina balthica*. Mixed with these were a few shells of the Oyster and of freshwater species such as *Unio pictorum* and *Paludina vivipara*. The first three species mentioned are Molluscs commonly found between tide marks and in estuaries, and their occurrence at this spot is an interesting reminder of the estuarine conditions which must have prevailed in the Bure and its tributaries as late as Roman times. The excellent preservation of the specimens, the two valves being often not separated, and the minute size of some of the individuals show that they were not the refuse from St. Benet's Abbey, but must have lived where they were found.—Robert Gurney.

Hydra.—This year (1908) *Hydræ* have been numerous in all the ditches I have tried: especially *Hydra viridis*, which was very prevalent in the vicinity of Stalham and Horsey Broads on Ranunculus and other plants. During July I made a special visit to South Walsham dyke, and found *Hydra fusca* in abundance, but a few weeks later in mid August came across a large variety of a very dark olive colour (almost black). This creature had the power of extending its tentacles to a much larger extent than any I had hitherto seen, viz., about ten times the length of its own body. I have carried out Trembley's experiment on one of these and met with complete success. For instance, I cut three tentacles off a fine specimen close to the stoma, and cut the body clean in half. In a few days the lopped tentacles grew to their original length, and the separated portion of the body commenced in a few days to put forth fresh tentacles and in fourteen days a perfectly new animal was produced.

This is entirely apart from the budding process. Another feature worthy of notice was that the severed tentacles lived and carried out their usual functions for several days, when I suddenly lost them whilst changing the water in which they were placed.—H. E. HURRELL, Great Yarmouth.

UNUSUAL NUMBER OF WOODCOCKS.—More Woodcocks were shot in Norfolk during the autumn of 1908 than has been the case for many a year, December in particular being a very productive month. Their abundance was probably owing to an extra good breeding season in Sweden and Norway, where Mr. Pratt informs me the close time now runs from March 15th to August 15th, as enacted by recent legislation which came into force on the 1st of January of the present year. I took some trouble to make a list of some of the best bags of Woodcocks in Norfolk, of which the principal were :

November 11th, 1908. Twenty-five shot at Sheringham.
December 1st, 1908. Forty-two shot at Swanton.
December 3rd, 1908. Nineteen shot at Swanton.
December 4th, 1908. Twenty-four shot at Swanton.
December 5th, 1908. Twenty-two shot at Felbrigge.
December 14th, 1908. Twenty-five shot at Hanworth.
December 14th, 1908. Seventeen shot at Gimmingham.
December 25th, 1908. Seventeen shot at Stratton Strawless.
December 30th, 1908. Nineteen shot at Witton.
December 31st, 1908. Sixteen shot at Runton.

Besides the above, there were many smaller bags, so the aggregate number of Woodcocks killed in the County must have been very large. Up to January 18th, 1909, the season had produced one hundred and thirty-three at Somerleyton, and ninety-six at Felbrigge. About the end of March a considerable number were observed in the vicinity of Cromer on their return passage, which must have been towards the north-east.—J. H. GURNEY, Keswick.

AZOLLA CAROLINIANA.—Whilst staying at Woodbastwick in 1908, during August and September, I found great quantities

of Azolla, which I believe to be *A. caroliniana*, growing in the dyke on the right side of the road leading from Woodbastwick to Horning Ferry, and quite near to the Ferry.

It was growing in such masses that the surface of the water was completely covered with it, and it was curious to notice that it was confined to this dyke, there being none in the dyke the other side of the road. I have never found it before, and it would be interesting to know when and how it got introduced there.

It has been found in Hainault Forest in Essex in 1904 (Essex Naturalist, vol. xiii., p. 352) and also in a pond at Highgate (l.c., p. 361). Specimens were sent, some time ago, to Dr. Plowright, from Worcestershire.

The Rev. M. C. H. Bird states that the plant is known to have lived through the winter of 1907-08, at Epping. Mr. Bird also sends the following note, copied from the Roy. Hort. Soc. for Nov. 1908 (p. 268), and signed G. R.

> AZOLLA FILICULOIDES (*A. magellanica*). "Introduced from California. Resemble miniature Selaginellas, but are aquatic. *A. filiculoides* is often mistaken for the more common *A. caroliniana*, but it has larger leaves, and though almost tropical, it survives the most severe continental winters. On the Dutch lakes, ponds, and ditches the plants form a thick covering—at first green, later reddish in colour—to the detriment of other weaker water-weeds. In October or November they decay, leaving the sporangia, which sink, to rise to the surface in May the following year, and however few may survive the winter, by July their numbers have increased by millions. They will not grow everywhere: the water must have a muddy bottom, with a certain amount of humus, and not too much lime. *A. caroliniana*, an older plant in Europe, increases much slower, and often disappears from places where it may have been at times plentiful."

Last September (1908), I brought a small bag full of Azolla from the dyke near Horning Ferry, and introduced them into a small pond in the garden at Woodbastwick Old Hall.

I visited the pond in the middle of April this year, and found many small plants of Azolla scattered all about over the surface of the water.

On visiting the pond again at the end of May, I found thousands of plants, chiefly of a reddish colour, some of the larger specimens having turned green, all over the surface of the pond.

It is wonderful to what an extent they have increased in so short a time, and it shows how careful one ought to be in introducing such rapidly increasing plants into new localities. The pond is almost covered with duckweed, and it will be interesting to see which plant dominates.

Last winter was a very severe one, so this species of Azolla is, apparently, quite hardy.—F. H. Barclay.

INDEX

TO THE

TRANSACTIONS

OF THE

NORFOLK & NORWICH NATURALISTS' SOCIETY.

1869—1908.

DATES OF PUBLICATION

OF THE

TRANSACTIONS OF THE NORFOLK & NORWICH NATURALISTS' SOCIETY.

Forming Vol. I.	1869–70.	pp. 1–64.	March,	1870.
	1870–71.	„ 1—92.	May,	1871.
	1871–72.	„ 1—70.	May,	1872.
	1872–73.	„ 1–120.	May,	1873.
	1873—74.	„ 1—85.	June,	1874.
	Supplement: Norfolk Lepidoptera.			1874.
Vol. II.	Part 1.	pp. i—viii, 1–108.	May,	1875.
„	„ 2.	„ i–xiv, 109–242.	June,	1876.
„	„ 3.	„ i—xii, 243–354.	May,	1877.
„	„ 4.	„ i–xiv, 355–590.	Aug.,	1878.
„	„ 5.	„ i—xvi, 501—638.	Aug.,	1879.
Vol. III.	Part 1.	pp. i—xiii, 1—154.	July,	1880.
„	„ 2.	„ i—xiii, 155—268.	Aug.,	1881.
„	„ 3.	„ i—xvi, 269—424.	Sept.,	1882.
„	„ 4.	„ i—xvi, 425—568.	July,	1883.
„	„ 5.	„ i—xviii, 569—789.	Sept.,	1884.
Vol. IV.	Part 1.	pp. i—xiv, 1—144.	Sept.,	1885.
„	„ 2.	„ i—xiv, 145—286.	June,	1886.
„	„ 3.	„ i—xiii, 287—432.	July,	1887.
„	„ 4.	„ i—xiv, 433—536.	Aug.,	1888.
	Supplement	537—554.		1888.
	Part 5.	pp. i–xv, 555—732.	Aug.,	1889.
Vol. V.	Part. 1.	pp. i—xv. 1—110.	June,	1890.
„	„ 2.	„ i—xvi, 111—230.	July,	1891.
„	„ 3.	„ —x, 231—332.	Aug.,	1892.
„	„ 4.	„ i—xix, 333—508.	Sept.,	1893.
„	„ 5.	„ i—xvi, 509—662.	July,	1894.
	and Catal. of Library, pp. 1—43.			

Vol. VI.	Part 1.	pp. i—xiv, 1—118.	Aug.,	1895.
,,	,, 2.	,, i—xv, 119—230.	Aug.,	1896.
,,	,, 3.	,, i—xvi, 231—330.	July,	1897.
,,	,, 4.	,, i—xiv, 331—420.	July,	1898.
,,	,, 5.	,, i—xiv, 421—555.	Sept.,	1899.
Vol. VII.	Part 1.	pp. i—xv, 1—114.	Sept.,	1900.
,,	,, 2.	,, i—xiii, 115—276.	July,	1901.
,,	,, 3.	,, i—xvi, 277—428.	July,	1902.
,,	,, 4.	,, i—xv, 429—584.	Aug.,	1903.
,,	,, 5.	,, i—xv, 585—756.	Aug.,	1904.
Vol. VIII.	Part 1.	pp. i—xvi, 1—154.	Aug.,	1905.
,,	,, 2.	,, i—xvi, 155—328.	July,	1906.
,,	,, 3.	,, i—xv, 329—498.	Aug.,	1907.
,,	,, 4.	,, i xvi, 499—626.	July,	1908.
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Abiogenesis, i, 1873-4, 11.
Addresses by various Presidents; see under person.
Aecidium clatinum in Norfolk, vii, 255.
Agaricus phalloides, poisoning by, iii, 152.
Algae, Marine, of Norfolk, iii, 532, viii, 809; of Suffolk, viii, 768.
Agriculture, Rooks and Owls and, vii, 581.
Agrotis saucia, iii, 33.
Alaska, Birds of, iv, 305.
Alcedo ispida, i, 1873-4, 82.
Algeria, Nat. Hist. Tour in, i, 1870-1, 35.
Alonopsis ambigua, viii, 150.
Amber in Norfolk, iii, 601; iv, 144, 247, 395.
—— Mrs. Burwood's Collection, v, 92.
Ambrosia peruviana, ii, 228.
Amblystoma, ii, 250.
Ampelis garrulus, 1872-3, 119; plumage of, iii, 326.
Amyot (T. E.), Winfarthing Oak, ii, 12; vi, 113.
—— obit., vi, 124.
Anguilla vulgaris, reproduction of, vi, 262.
Animals, Foreign, in British Parks, vi, 360.
Ant, The, Flora of District, viii, 265.
Antarctic, Distribution of Life in, vii, 431.
Apamea ophiogramma, iii, 33, 69.
Apantedes stauropodis, iv, 689.
Aphidae, swarm of, i, 1869-70, 64.
Aplin (O. V.) *Lanius collurio* in Great Britain and Ireland, v, 286.
Appendicularia flabellum, light from, ii, 616.
Aquila chrysaetos, 1869-70, 59.
Ardea alba in Great Britain, v, 186.
Ardea candidissima in Norfolk, iii, 565.
Arderon (W.), memoir, ii, 429.
Argyroneta, Nest of, ii, 614.
Arran More, Nat. Hist. of, iv, 463, 677.
Artemesia campestris, viii, 343.
Atmore (E. A.), Hymenoptera of Norfolk, viii, 821.
Arvicola glareolus, ii, 60.
Atriplex pedunculata in England, viii, 35.
Axolotl, ii, 250.
Azolla caroliniana, viii, 856.
Babington (C. C.), Plants near Cromer in 1875-6, ii, 380.
Backhouse (Jas.), Sale of Norfolk fossils, viii, 624.
Bacteria, iv, 6; v, 8.
Bagous lutosus in Norfolk, viii, 102.
Balaena biscayensis on the E. coast of Scotland, iii, 228.
Balaenoptera musculus, ii, 61, 222.
Barclay (F. H.), On *Azolla caroliniana*, viii, 856.
Barnard (A. M.), *Lobelia urens*, iii, 424.
—— *Potentilla norvegica*, iii, 567.
—— *Thrincia tuberosa*, iv, 143.
Barrett (C. G.), Coast Insects found at Brandon, i, 1870-1, 61; i, 1871-2, 40.
—— Larva of unknown Lepidopteron, i, 1869-70, 27.
—— Lepidoptera of Norfolk, Suppl. to 1873-4, 1; iii, 683; iv, 691; vi, 533.
—— on *Vanessa antiopa*, i, 1872-3, 24.
—— Wild Cattle at Chillingham, ii, 51.
—— Obit., viii, 152.

Barrington (F.), Waterhen's nest made of Peacock's feathers, vi, 552.
Barwell (H. G.), Obit., vi, 426.
Bass Rock, ii, 528.
Bates (Rev. J.), Obit., ii, 501.
Bayfield (T. G.), Address, ii, 243.
—— Obit., v, 336.
Bees and Birds, i, 1870-1, 91.
Bees collect pollen from flowers of one species, ii, 226.
Bennett (A.), Additions to Flora of Norfolk, iii, 633.
—— *Carex paradoxa* and *Lastrea cristata* in Britain, vii, 695.
—— *Chara tomentosa*, iii, 568.
—— *Deschampsia setacea*, viii, 694.
—— Distrib. of *Peucedanum palustre* and *Lathyrus palustris* in England, vii, 467.
—— Distribution of *Sonchus palustris* and *Atriplex pedunculatus* in England, viii, 35.
—— Distribution of *Veronica verna*, *V. triphyllos*, *Herniaria*
—— *glabra*, and *Scleranthus perennis*, viii, 528.
—— East Anglian Plants, viii, 687.
—— *Holosteum umbellatum*, *Statice reticulata*, and *Phleum boehmeri*, viii, 231.
—— *Liparis loeselii*, vii, 333, 620; viii, 340.
—— *Liparis loeselii* and *Teucrium scordium* in England, vii, 333.
—— Naiadaceae and Characeae of Norfolk, iii, 379.
—— *Pyrola rotundifolia*, vii, 512.
—— *Senecio*, vi, 457.
—— *Silene otites*, *Artemisia campestris*, and *Chenopodium botryoides* in East Anglia, viii, 343.
Beverley M.), Address, i, 1872-3, 7.
—— Edible fungi of Norfolk, i, 1872-3, 90.
Bidgood (J.), *Chara polyacantha*, v, 424.
Bidwell (E.), Egg of *Otis tarda*, iv, 140.
—— List of birds in whose nest the egg of Cuckoo has been found, iii, 526.
Bidwell (E.), Scilly in the nesting season, iv, 201.
Bidwell (W. H.), Address (1902), vii, 277.
—— Memoir of R. Wigham, vii, 298.
—— Norfolk names derived from Animals and Plants, iii, 212.
—— Obsolete dishes, iv, 587.
—— Flowering of *Nycterinia capensis*, vii, 582.
—— Teasel in Norfolk, use of, vii, 147.
Biological Station, vi, 108.
Bird (M. C. H.), *Rallus aquaticus*, vi, 118.
—— Address, viii, 627.
—— On the Viper, vii, 243.
Birds and Bees, i, 1870-1, 91.
—— Feeding of, in 1707, iv, 393.
—— Feeding, Wind and, iv, 43.
—— Flight of, i, 1869-70, 41.
—— Gallinaceous, assumption of male plumage no proof of barrenness, iv, 391.
—— and Lighthouses, i, 1871-2, 63.
—— in the Meres, viii, 747.
—— Migration of, in England and Heligoland, iv, 52.
—— nesting in Norfolk, iv, 679.
—— Nesting Boxes for, ii, 195.
—— Nesting Habits of, ii, 195.
—— Plumage of, iv, 61.
—— of Prey, Food of some American, iv, 609.
—— Raptorial, in the Lilford Aviaries, iv, 564; other birds, v, 128.
—— Register of singing of, i, 1870-1, 34.
—— Tendency to resemble other species, vi, 240.
—— Protection of, i, 1871-2, 13; 1872-3, 105.
—— Wild, Protection, Memorial, vi, 413.
—— Wild, Protection Act, i, 1872-3, 105.
—— Wild, Protection Acts as applied to Norfolk, vi, 207; viii, 322, 493, 622, 852.
—— of Alaska, iv, 305.
—— Of the Farne Islands, v, 52.
—— of Handa, viii, 503.
—— of Holland, v, 166.
—— Irish Rock, v, 550.

Birds on the Kimberley Estates, ii, 46; iv, 604.
—— of Lena Delta, iv, 301.
—— of Lincolnshire, ii, 555.
—— migrating from Lowestoft, vi, 227.
—— of Mascarene Islands, iv, 548.
—— of Norfolk, iv, 259, 397; v, 200, 421, 642; vi, 501; vii, 733; viii, 847.
—— Rare, in Norfolk in 1890-91, v, 200.
—— of Pembrokeshire, vii, 627.
—— of Ruston, viii, 647.
—— of Seychelles, iv, 548.
—— of Somme Valley, vi, 444.
—— of Spain, vii, 701.
—— Spring migration at St. Leonards, iii, 170.
—— of Switzerland, vi, 255.
—— of Thetford, i, 1870-1, 83.
—— of Yarmouth, vi, 291, 405, 484.
Birkbeck (E. L.), Obit., vii, 422.
Bishop and Clerks Birds, vii, 634.
Blackbird and Thrush. Do they interbreed? iii, 588; iv, 582.
Blakeney Harbour, viii, 333.
—— Ornithology of, iv, 36; viii, 852.
Bleakley (E.), Life, vi, 218.
Bloomfield (E. N.), Norfolk Diptera, vii, 541.
—— Algæ of Suffolk, viii, 768.
—— Algæ of Norfolk, iii, 532; viii, 809.
—— Fungi of Suffolk, viii, 246.
—— Galls of Norfolk, vii, 110.
—— Hepaticæ of Norfolk, vii, 552; viii, 148.
—— Hymenoptera of Norfolk, vii, 428; viii, 811.
—— Lichens of Norfolk, viii, 117.
—— Mosses of Suffolk, vii, 227, 427.
Blyth (E.), Life and Writings, iii, 38.
Boileau (Sir F. G. M.), Address, (1897), vi, 231.
Boletus sulphureus, iii, 151.
Bombycilla garrula, i, 1872-3, 119.
Bond (F.), Obit., v, 8.
Borrer (W.), Obit., vi, 427.
Bos longifrons, i, 1869-70, 40.
Botanical Divisions in Norfolk, i, 1869-70, 19.
Botanical Notes (1885), iv, 255; (1887) iv, 511; (1889), v, 108.
—— Survey of the Broads, viii, 618.
Botanists of Norfolk, viii, 374.
Botany in Norway, iv, 630.
Boulter (D.), Life, vi, 81.
Box vulgaris, vii, 584.
Braikenridge (Rev. G. W.), Obit., iii, 426.
Brama rayi, v, 421.
Brandon, Coast Insects found at, i, 1871-2 40; i, 1870-1 61.
Breck, The, Insects of, viii, 579.
Breckland characteristics, viii, 555, 677.
Breydon Wild Birds Protection Society, viii, 496, 854.
Bridgman (J. B.), Address, ii, 111.
—— *Apantales stauropolis*, iv, 689.
—— Bees collecting pollen from flowers of one species only, ii, 226.
—— *Cryptus pygolcucus*, iv, 144.
—— *Glypta*, v, 61.
—— Hymenoptera (list) of Norfolk, ii, 617; iii, 367; iv, 523, 690.
—— Hymenoptera of Norwich, v, 61.
—— Hymenoptera aculeata, ii, 118; ii, 275.
—— Ichneumons of Norfolk, v, 603.
—— Instinct at fault, iv, 397.
—— *Lepisma saccharina*, tenacity of life in, i, 1873-4, 80.
—— *Macropis labiata*, ii, 62.
—— Land and fresh-water Mollusca of Norfolk, i, 1871-2, 47.
—— *Myrmica lobicornis*, iv, 394.
—— *Nomada succincta*, monstrous, ii, 227.
—— *Pezomachus corruptor*, vi, 114.
—— Nidification of *Prosopis*, i, 1873-4, 68.
—— *Vespa vulgaris*, nest of, iv, 50.
—— Obit., vii, 101.
Bridgman (W. K.), Memoir, vi, 217.
Brightwell (T.), Memoir, vi, 215.
British Assoc. at Dublin, viii, 684.
British E. Africa, Nat. Hist. in, viii, 696.

Broads, Bionomical investigation of, vii, 661.
—— Botanical Survey of the, viii, 618.
—— List and areas of, i, 1871-2, 37.
—— Origin of, i, 1871-2, 30.
Bronze Age, viii, 393.
Brooke (W.), Memoir, vi, 217.
Brown (J. L.), Memoir, vi, 216.
Browne (F. B.), Bionomical Investigation of Norfolk Broads vii, 661.
—— Early Stages in Life History of Fresh-water Fishes, viii, 478.
—— *Emys orbicularis*, vii, 754.
—— Aquatic Coleoptera in the Broads, viii, 58, 290.
Browne (Sir Thos.), ii. 26.
—— On Birds of Norfolk, i, 1870-1, 19.
—— As a Naturalist, vii, 72.
Brownfield (J.), Obit., iv, 537.
Bryant (Chas.), ii. 29 : viii, 381.
Bryant (Hy.), ii, 27 ; viii, 381.
Bulwer (W. D.), Otter Breeding in November, v, 420.
Bunting, Ortolan, at Yarmouth, i, 1871-2, 61.
Burlingham (D. C.), Life of, vii, 414.
Burrell (W. H.), *Æcidium elatinum* in Norfolk, vii, 255.
—— *Leucobryum glaucum*, viii, 537.
—— *Mertensia maritima*, viii, 201.
—— Myeetozoa of Norfolk, vi, 449.
Butler (E. A.), *Diomeda melanophrys* in Cambridgeshire, vi, 414.
—— *Pernis apivorus* in Suffolk, vi, 416.
Buxton (H. E.), Obit., viii, 155.
Buxton (Miss M. L.), Trip to Spain, viii, 667.
Calamodus aquaticus, i, 1871-2, 62.
Calcarius lapponicus, v, 372.
Callitriche obtusangula, iii, 634.
Camden (Wm.), On Norfolk Birds, i, 1870-1, 14.
Candler (C. & H.), Bird Life of the Skellig Rocks, v, 40.
—— Birds of Holland, v, 166.
Caprimulgus europæus, v, 73.
Cardamine palustris, vii, 583.
Carex paradoxa, vii, 695.
Carex trinervis, iii, 635.
Cattle at Chillingham, ii, 51.
Cervus elaphus, i, 1869-70, 40.
Cetaeea at Yarmouth, v, 326 ; vi, 116.
—— Ancient records of, vii, 303.
Chara obtusa, iii, 268.
Chara polyacantha, v, 424.
Chara tomentosa, iii, 568.
Characeæ of Norfolk, iii, 379.
Charadrius fulvus, ii, 214.
Chenopodium botryoides, viii, 348.
Chillingham Cattle, ii, 51.
Chiton laevis, iii, 789.
Chitons at Cromer, iii, 789.
Christy (R. M.), Do the Blaekbird and Thrush ever interbreed ? iii, 588 ; iv, 582.
—— *Monodon monoceros* in Norfolk in 1577, vi, 204.
Cicindela campestris, ii, 615.
Ciconia alba, i, 1873-4, 82.
Cinclus aquaticus, i, 1872-3, 114.
Cladoeera, viii, 44.
Clarke (W. G.), Breckland Characteristies, viii, 555, 677.
—— Bird-life in the Meres, viii, 747.
—— Distribution of Flint and Bronze Implements in Norfolk, viii, 393.
—— "Flint Jack," vi, 463.
—— Neolithic Implements, viii, 25, 215, 552.
—— *Sterna fuliginosa*, vii, 752.
—— Nat. Hist. of Thetford, viii, 386.
—— Neolithic Man in Thetford, vi, 23.
—— Vertebrata of Thetford, vi, 300.
—— Wretham Meres, vii, 499.
Clathrocystis æruginosa, ii, 227.
Cley-next-the-Sea, Birds of, iii, 345 ; iv, 36, 186 ; viii, 852.
Climate of Norfolk, ii, 31 ; iv, 337.
Clupea harengus, varieties and distribution of, v, 584.
Coccothraustes vulgaris, i, 1872-3, 118 ; i, 1873-4, 84.
Coleoptera of Norfolk, vi, 427 ; vi, 515 ; vii, 744 ; viii, 52, 290, 826.
—— of Norfolk and Suffolk, vii, 706.

Coleoptera of Suffolk, v, 661.
—— Aquatic, of Norfolk, viii, 58, 290.
Colman (J. J.), Obit., vi, 425.
Coloration, vii, 130.
Columba œnas, ii, 613.
Coot, viii, 449.
Coot-shooting on Hickling Broad, vii, 267.
Cordeaux (J.), Migration of Stonechat, ii, 264.
—— Birds of Lincolnshire, ii, 555.
—— Obit., vii, 100.
Corder (E.), Woad, v, 144.
Corder (O.), Address, iii, 155.
—— Nat. Hist. Notes from Portugal, iv, 173.
—— On Saffron, iv, 21.
Corticium chrysanthemi, viii, 496.
Corton, Geology of, iii, 71 ; iv, 606.
Crabs, vii, 124.
—— Respiration in Sand-burrowing, viii, 22.
Cresswell (F. J.), Obit., iii, 426.
Cromer Lighthouse and Birds, i, 1871-2, 63.
Crompton (J.), Address, i, 1869-70 3, 13 ; 1870-1, 3.
—— Obit., ii, 501 ; vi, 218.
Crossbills Nesting in Suffolk, iv, 168.
Crow, Carrion, Nesting Habits, iii, 68.
Crowe (Jas.), Obit., viii, 381.
Crowfoot (W. M.), Study of Entomology, i, 1869-70, 29.
Crustacea of Norfolk, vii, 637 ; viii, 410.
Cryptus pygoleucus, iv, 144.
Cuckoo, Birds in whose Nest the egg of has been found, iii, 526.
Cuculus, economy of, vi, 365.
Curlew Breeding in Norfolk, vii, 276.
Cygnus immutabilis, ii, 258.
Cypselus alpinus, i, 1872-3, 117.
Dalrymple (D.), Memoir, vi, 217.
Dalyell (Sir J. G.), Work of, vii, 123.
Darkness and Eyes, iii, 604.
Day (F.), Eels of Norfolk, iv, 333.
—— Obit., v, 7.
Decoy, Feltwell, vi, 352.
Decoys, Norfolk, ii, 538.
—— Early, vii, 606.
Delphinus albirostris, ii, 333 ; i., 149, 421.
Deschampsia setacea, viii, 694.
Desmids, i, 1870-1, 54.
Devil's Punch Bowl, vii, 508.
Diablotin, v, 24.
Diary of 1800-2, Leaves from a, vii, 453.
Diastataxy, vii, 312.
Diatoms, i, 1870-1, 50.
Diatomaceæ of Norfolk, ii, 336 ; iii, 754.
Dictyoptera lorquiniana, ii, 29.
Diomedea melanophrys in Cambridgeshire, vi, 114.
Diptera of Norfolk, vii, 541.
Disease germs, iv, 294.
Dishes, obsolete, iv, 587.
Dispar, iv, 90.
Diverson (T.), Notice of, vi, 72.
Dix (F.), Rainfall iv, 676.
—— Rainfall in 19th century, vii, 260.
—— Obit., vii, 577.
Dixon (H. N.), Norfolk Mosses, vii, 212, 427, 558.
Dolphin, markings in skin of, vii, 185.
Dominica, Diablotin of, v, 24.
Doubleday (H.), Norfolk Birds in his Collection, ii, 225.
Dowell (E. W.), Obit., vi, 124.
Downes (J. D.), Memoir, v, 183 ; vi, 72.
Drayton on Norfolk Birds, i, 1870-1, 14.
Dresser (H. E.), European Warblers, vi, 280.
Duck, Red-crested Whistling, ii, 225.
Du Port (J. M.), Fungi at Downham, v, 558.
—— Fungi near Mattishall (1889), iii, 200
—— Obit., vi, 426.
Dutt (W. A.), Alien Plants at Oulton Broad and Lowestoft, vii, 623.
Dye Plants, British, vii, 386.
Eade (Sir P.), Address, 1887, iv, 287.
—— My City Garden, vii, 32.
—— Tortoises, iv, 316 ; v, 368.
Earthquakes in Norfolk, iii, 637.
—— of Ap., 1884, iv, 31.
Earthworms of Norfolk, v, 574.

Edwards (J.), *Bagous lutosus* in Norfolk, viii, 102.
—— Coleoptera of Norfolk, v, 427; vi, 515; vii, 744; viii, 826.
—— *Gastrodes abietis*, iii, 265.
—— Hemiptera of Norfolk, ii, 490; iii, 700; iv, 702; v, 650; vi, 528; vii, 746; viii, 840.
Eels, growth of, v, 660.
—— of Norfolk, iv, 333.
Eldred (E. J. H.), Foreign Animals in British Parks, vi, 360.
—— *Otis tarda*, viii. 727.
Elton (J. W.), Mention of, ii, 392, 408.
Emerson (P. H.), Birds migrating from Lowestoft, vi, 227.
Empusa musci, i, 1873-4, 63.
Emys luraria, i, 1869-70, 40.
Emys lutraria at Mundesley, iii, 36.
Emys orbicularis, vii, 754.
Entomological Notes (1880), iii, 262; (1881) 383; (1902) vii, 526, 635.
Entomology, Study of, i, 1869-70, 29.
Epilobium roseum, iv, 323.
Equisetum variegatum, iii, 567,
Ergot on Wheat, iii, 152.
Ergots, iii, 268.
Erigeron canadense, iii, 567.
Erithacus suecicus, in Norfolk, iii, 597.
Erratics at Mundesley, vii, 7.
Euphorbia esula, iii, 70.
Evans (H. M.), Poisoned spines of *Trachinus draco*, viii, 355.
Extinction of native races by man, iii, 9.
Extinction by indirect acts of man, iii, 175.
Eyes, iii, 604.
Falconry in Norfolk, v, 183.—See Hawking.
Faults (Post-glacial) on the East Coast, vii, 423.
Feilden (H. W.), Address (1886), iv, 145.
—— Diablotin, v. 24.
—— Flora of Kolguev, vi, 168.
—— Flora of Lapland, vi, 16.
—— Flora of Spitsbergen, vi, 47.
—— Nat. Hist. in Franz Josef Land, iii, 201.
Feilden (H. W.), *Halichœrus gryphus*, v, 419.
—— *Larus sabinei*, v, 421.
—— *Laemargus microcephalus*, iv, 254.
—— Animals and plants on Ben Nevis, vi. 254.
—— Stone Implements of Norfolk, iv, 516.
—— *Otis tarda*, iv, 519.
—— Zoology of Markham's Voyage to Hudson's Bay in 1886, iv, 344.
Feltwell, Decoy at, vi, 352.
Fens and Fen-folk, iii, 610.
Ferns of Norfolk, ii, 240; iii, 729; iv, 727.
Festuca ambigua, iii, 268.
Filaria sanguinis hominis, v, 547.
Finches, hybrid, iv, 367.
Fishes of Norfolk, i, 1873-4, 21; iii, 677; v, 634; vi, 495; vii, 741; viii, 844.
—— from Yarmouth, vi, 115, 225, 293, 407, 484.
—— Rare, at Great Yarmouth, v, 227, 323.
—— Fresh-water, early stages in life-history of, viii, 478.
—— Protective instinct in, vi, 440.
Fisheries, Fresh-water, of Norfolk. iv, 433.
Flight of Birds, i, 1869-70, 41.
"Flint Jack," vi, 463.
Flints in Chalk, vii, 148.
—— Spongeous Origin of, i, 1871-2, 51; 1873-4, 81.
Flood of 1852-3, v, 560.
Flora of Arctic Freshwater Bed, vii, 292.
—— Arctic, in British Isles, vi, 125.
—— of Cromer, ii, 380.
—— of East Anglia, viii, 687.
—— of Forest-bed, iv, 189.
—— of Gt. Yarmouth, vi, 137.
—— of Harleston, iv, 395, 578.
—— of Hudson's Bay, iv, 354.
—— of Norfolk, ii, 71; iii, 379, 561, 567, 633, 719; iv, 142, 322, 496, 711; v, 652; vii, 514, 552, 623, 748; viii, 117, 148, 265.
—— of Norway, iv, 630.
—— of Russian Lapland, vi, 161.
—— of Spitsbergen, vi, 47.
—— of Wells, iv, 371; viii, 523.

"Florists' Feast," viii, 375.
Flosculariae of Yarmouth, viii, 625.
Foord (A. S.), Amber belonging to Mrs. Burwood, v, 92.
Forest-bed, iv, 470.
—— Additions to Fauna and Flora, iii, 631.
—— Flora, iv, 189.
—— Seeds, viii, 624.
—— Vertebrata, iii, 654.
—— Whales, v, 425.
Fort Churchill, Flora of, iv, 354.
Fowler (W. W.), Birds of Somme Valley, vi, 444.
Fowlmere, vii, 505.
Fox (Jos.), ii, 26, 30; viii, 380.
Franz Josef Land, Nat. Hist. in, iii, 201.
Freeman (R.), Rotifera of Norfolk viii, 137.
Frere (F.), Mention of, vi, 82.
Frere (H. T.), Obit., v, 114.
Frost, Great, of 1890-91, v, 191.
—— Great, of 1894-5, vi, 95.
—— Rime, of January, 1889, v, 18.
Frosts, Great, 1790-1890, v, 196.
Fulmarus glacialis in confinement, iv, 223.
Fungi on Whale's bones, ii, 335.
—— found at Brandon, ii, 260.
—— at Downham, v, 558.
—— near Mattishall, iii, 200.
—— of Norfolk, i, 1872-3, 28; iii, 730; iv, 728.
—— at Scoulton Mere, ii, 130.
—— of Suffolk, viii, 246.
—— Edible, of Norfolk, i, 1872-3, 90.
—— Micro-, i, 1873-4, 63.
Gale, great, March, 1895, vi, 99.
Gallinula chloropus, hairy variety, iv, 143.
Galls, Norfolk, vii, 110.
Galpin (F. W.), Flora of Harleston, iv, 226, 395.
Gannet City, ii, 528.
Gardens, vii, 32.
Garrulus infaustus vii, 583.
Garstang (W.), Address, 1905, viii, 1.
—— Nat. Hist. of North Sea, viii, 5.
—— Respiration in Sand-burrowing Crabs, viii, 22.
Gastrodes abietis, iii, 265.
Gatcombe (J.), Obit., iv, 537.
Gatke (H.), Obit., vi, 233.
Gaster coliformis, iii, 266.
Geldart (Alice), *Stratiotes aloides* viii, 181.
Geldart (H. D.), Addresses, ii, 1; iii, 425; (1896) vi, 119.
—— Algæa, Marine, of Norfolk, iii, 532.
—— *Ambrosia peruviana*, ii, 228.
—— Botan. Notes (1884), iv, 142; (1885), iv, 255; (1887), iv, 511; (1889), v, 108; (1890), v, 328; (1891), v, 329; (1892) v, 330.
—— Division of County for Botanical Purposes, 1869-70, 19.
—— *Filaria sanguinis hominis*, v, 547.
—— Flora of Harleston, iv, 578.
—— Flora of Hudson's Bay, iv, 354.
—— Flora of Kolguev, vi, 168.
—— Flora of Russian Lapland, vi, 161.
—— Flora of Ben Nevis, vi, 247.
—— Flora of Norfolk, ii, 71, 229.
—— Flora, Additions to Norfolk, iii, 268; iii, 567, 719; iv, 711; v, 652.
—— Flora of Spitsbergen, vi, 47.
—— Mistletoe, vi, 453.
—— *Populus fastigiata* in Norfolk, iii, 354.
—— *Pyrola minor*, ii, 335.
—— *Sambucus racemosa*, iv, 689.
—— *Spiræa tomentosa*, iv, 689.
—— Symbiosis, iii, 432.
—— Life and writings of Edward Blyth, iii, 38.
—— Memoir of, vii, 573.
—— Mention of, viii, 385.
Gems, vii, 15.
Geography, Physical, of Norfolk, iii, 449.
Geology of Norfolk, ii, 378; iii, 441; vii, 477.
—— East Anglian, vii, 477.
Geranium rotundifolium, iii, 561.
Girdlestone (C. S.), ii, 389; vi, 76.
Glasspoole (H. G.), Memoir of Lilly Wigg, ii, 269.
—— Obit., iv, 289.
Glasspoole (H.), Mention of, vi, 78.

Globicephalus melas, ii, 611.
Glypta, v, 61.
Grapholitha erectana, iii, 316.
Grasses of Norfolk, ii, 237.
Grassholm Birds, vii, 633.
Gray (Robt.), Obit., iv, 290.
Great Copper Butterfly, iv, 90.
Grebe, Great Crested, viii, 449.
Grus cinerea, i, 1869-70, 60; 1873-4, 83.
Grus communis in the Fens, vii, 158.
Grus communis breeding in E. Anglia, vii, 160.
Guist, Granite boulder at, vii, 754.
Gull, Little, abundance in 1869-70, i, 1870-1, 65.
Gulls, movements of, on the Norfolk coast, iv, 326.
Gunn (J.), Obit., v, 113.
Gunn (T. E.), *Otis tarda* in Norfolk, v, 656.
Gurney (Anna), Note book of, ii, 19.
Gurney (Eustace), Address, 1906 viii, 155.
—— Limnology, viii, 159.
Gurney (G. H.), Nat. Hist. in B. E. Africa, viii, 696.
Gurney (John), Obit., iv, 288.
Gurney (J. H.), [1819-1890.]
—— Birds, feeding of, in 1707, iv, 393.
—— Birds of Prey, food of some American, iv, 609.
—— Note book of Anna Gurney, ii, 19.
—— Hawking in 1653-6, iv, 393.
—— Hawking in 1783, ii, 224.
—— License for Shooting in 1554, ii, 614.
—— Mammalia of Norfolk and Suffolk, i, 1869-70, 22.
—— Martens in Suffolk in 1811, ii, 223.
—— Northrepps Churchwardens' Accounts, ii, 611,
—— *Pernis apivorus*, female of, iv, 249.
—— Seal, Sturgeon and Eels in the Ouse, iii, 422.
—— Vipers, ii, 613.
—— Woodcocks drowned while migrating, ii, 488.
—— Obit., v, 115; memoir, 156.
Gurney (J. H. *filius*).
—— Addresses (1882), iii, 269; (1889), iv, 555; (1899), vi, 421.
—— *Ardea alba* in Great Britain, v, 186.
—— *Ardea candidissima*, iii, 565.
—— Bass Rock, ii, 528.
—— Birds from Cley, iii, 350.
—— Birds of the Farne Islands, v, 52.
—— Birds, Irish Rock, v, 550.
—— Birds of Norfolk, iv, 259, 397; v, 642; vi, 501; vii, 733; viii, 847.
—— Birds of the Pembrokeshire Islands, vii, 627.
—— Birds of Switzerland, vi, 255.
—— Birds feeding, wind and, iv, 43.
—— Birds, Gallinaceous, assumption of male plumage no proof of barrenness, iv, 391.
—— Birds and Cromer Lighthouse, i, 1871-2, 63.
—— Birds, Migration of, in England and Heligoland, iv, 52.
—— Birds, Spring migration at St. Leonards, iii, 170.
—— Birds, tendency to resemble other species, vi, 240.
—— Bunting, Lapland, at Cley, i, 1871-2, 65.
—— Bunting, Ortolan, at Yarmouth, i, 1871-2, 61.
—— *Calamodus aquaticus*, i, 1871-2, 62.
—— *Calcarius lapponicus*, v, 372.
—— *Caprimulgus europæus*, v, 73.
—— Coot shooting on Hickling Broad, vii, 267.
—— *Cuculus*, economy of, vi, 365.
—— Doubleday's Norfolk Birds, ii, 225.
—— Duck, red-crested whistling, ii, 225.
—— Ducks, food of, v, 331.
—— *Erithacus suecicus* in Norfolk, iii, 597.
—— *Gallinula chloropus*, hairy variety, iv, 143.
—— The Gannet City, ii, 528.
—— *Garrulus infaustus*, vii, 583.
—— Wild Geese struck by lightning, viii, 325.

Gurney (J. H. *filius*).
—— Gulls, movements of, on the Norfolk Coast, iv, 326.
—— Heron, Squacco, in Norfolk, ii, 487.
—— *Lanius meridionalis* in Norfolk, viii, 352.
—— *Mergulus alle*, vi, 67.
—— Moorhen, Hairy variety of, iii, 581.
—— *Motacilla cinereicapilla*, ii, 226.
—— *Muscicapa parva* at Scilly, iv, 688.
—— Nat. Hist. in Spain and Algeria, i, 1870-1, 35.
—— Ornithological Notes (1882-3), iii, 511.
—— Ornithological Notes from Scotland, iii, 517.
—— Ornithological Notes from S. Norway, vii, 367.
— Owl, Snowy, at South Repps, i, 1871-2, 63.
— Owl, Tengmalm's, iii, 424.
—— *Panurus biarmicus*, vi, 429.
Pastor, Rose-coloured, ii, 225
—— *Phaëton* in England, v, 659.
—— Pheasants in Suffolk in 1467, v, 332.
—— *Puffinus anglorum*, iv, 447.
—— Ruff, nesting of, iii, 423.
—— *Ruticilla phœnicurus*, female assuming male plumage, iv, 182.
—— *Sclateglaux albifacies*, vi, 154.
—— Scilly Islands, iv, 447.
—— Sparrows eating Bees, iv, 522.
—— Sparrow, hybrid, iv, 522; v, 660.
—— Tern, Caspian, iii, 565.
—— Thrush tribe in England, iv, 619.
—— Wagtails, hybrid, iv, 521.
—— Woodcocks, abound in 1908, viii, 856.
—— Flights of Wood-pigeons, vii, 427.
Gurney (J. N.), Obit., vii, 578.
Gurney (R. J. H.), Obit., vii, 98.
Gurney (Robt.), *Monopsis ambigua*, viii, 150.
— Cladocera, viii, 44.
— Crustacea of Norfolk, vii, 637.
— Crustacea of E. Norfolk rivers, viii, 410.
Haigh (G. H. C.), *Luscinioda schwarzi* in Lincolnshire, vi, 492.
Haliaëtus albicilla, i, 1873-4, 81.
Halichœrus gryphus, v, 419.
Halichœrus gryphus on Breydon, iii, 564.
Hamond (C. A.), Address, (1907), viii, 329.
—— Blakeney Harbour, viii, 333.
—— Granite Boulder at Guist, vii, 754.
—— Spain and its birds, vii, 701.
Hamond (P.), Obit., iv, 291.
Hamond (Robt.), ii, 389, 400.
Handa, Birds of, viii, 503.
Hare, Tame, viii, 540.
Harleston, Flora of, iv, 226.
Harmer (F. W.), Address (1877), ii, 355; (1878), ii, 501.
—— Geology of Corton, iii, 71.
—— Implement from Hellesdon, v, 569.
—— Marine Mollusca of Norfolk, i, 1871-2, 42.
—— *Tellina balthica* and the Norwich Crag, ii, 377.
Harmer (S. F.), Address (1901), vii, 115.
—— Darkness and Eyes, iii, 604.
—— Markings on skin of Dolphin, vii, 185.
—— *Xiphargus* near Norwich, vi, 489.
—— Pelican in Cambridgeshire Fens, vi, 363.
Harris (G. H.), Flora of Gt. Yarmouth, vi, 137.
—— Herring Fishery, (1896), vi, 269; (1897), vi, 402; (1898), vi, 481.
Harting (J. E.), Hawking in Norfolk iii, 79; vi, 248.
Harvie-Brown (J. A.), Birds of Priest Island, iv, 310.
—— Shiant Islands and their bird-life, iii, 47.
Hawking in 1653-6, iv, 393.
—— in 1783, ii, 224.
—— in Norfolk, iii, 79; vi, 248.
—— near Yarmouth, iii, 34.
Hawks, iv, 650.
Heddle (M. F.), Geology and Mineralogy of the Shiant Isles, iii, 61.
Helix pomatia, viii, 354.
Helvella infula, iii, 151.

Hemiptera of Norfolk, ii, 490; iii, 700; iv, 702; v, 650; vi, 528; vii, 746; viii, 840.
Henderson (J.), Mention of, iv, 90.
Hepaticæ of Norfolk, vii, 552; viii, 148.
Herniaria glabra, viii, 528.
Heron, Purple, i, 1871-2, 65.
—— Squacco, in Norfolk, ii, 487.
Heronry on the Danube, iv, 170.
Herring Fishery of (1881), iii, 369; (1882), iii, 539; (1883), iii, 644; (1884), iv, 74; (1885), iv, 239; (1886), iv, 374; (1887), iv, 476; (1888), iv, 682; (1889), v, 86; (1890), v, 211; (1891), v, 310; (1892) v, 403; (1893), v, 578; (1894) vi, 53; (1895), vi, 147; (1896), vi, 269; (1897), vi, 402; (1898), vi, 481; (1899), vii, 49; (1900), vii, 262; (1901), vii, 354; (1902), vii, 536; (1903), vii, 682; (1904), viii, 97; (1905), viii, 307; (1906), viii, 455; (1907), viii, 599; (1908), viii, 763.
Herrings, vi, 15.
Hobby, Nesting of, iii, 351.
Holkham, Shooting at, v, 379.
Holland, Birds of, v, 166.
Holosteum umbellatum, viii, 231.
Hooker, (W. J.), viii, 382.
Hotblack (J. T.), Address, (1900), vii, 1.
—— British Association at Dover, vii, 106.
—— Herrings, vi, 15.
—— Norwich Castle Mound, viii, 338.
—— Precious Stones, vii, 15.
—— Stones on Mundesley Beach, vii, 7.
—— *Mus rattus* at Yarmouth, vi, 229.
Hoy (J. D.), ii, 390, 404.
Hudson's Bay, Flora of, iv, 354.
—— Zoology of, iv, 344.
Humfrey (W.), viii, 380.
Hunstanton, Entomology of, viii, 489.
— Plants near, vii, 514.
Hurrell (H. E.), Flosculariæ from Yarmouth, viii, 625.
—— Pond life of Yarmouth, vii, 755.
Hurrell (H. E.), Rotifera, &c., from Yarmouth, vii, 275, 833.
Hydra in Norfolk, viii, 855.
Hydrachnida of Norfolk Broads, viii, 83.
Hydrilla palustris, iii, 32.
Hydroids, vii, 119.
Hymenoptera of Norfolk, ii, 617; iii, 367; iv, 523, 690; vii, 428; viii, 811.
—— of Norwich, v, 61.
—— of Suffolk, vi, 36.
—— at Tostock, vi, 227, 328, 419, 554; vii, 13, 156, 330.
—— aculeata, ii, 118, 275.
Hyperoodon rostratus, iii, 476.
Ichneumons of Norfolk, v, 603.
Implement from Hellesdon, v, 569,
—— in Breckland, viii, 682.
—— Flint, viii, 25, 215.
—— Stone, of Norfolk, iv, 516; viii, 552.
—— Distribution in Norfolk, viii, 393.
Insects, coast, at Brandon, i, 1871-2, 40; i, 1870-1, 61.
—— Extinct Fen, v, 235.
Instinct at fault, iv, 394.
Invertebrates, Nat. Hist. of Aquatic, vii, 115.
Irby (L. H. L.), Obit., viii, 327.
Isatis tinctoria, v, 144.
Jack, Crowning of, vii, 114.
Jackdaw casting pellets, i, 1870-1, 89.
Johnson (R.), List of Extinct Mammalia of Norfolk, ii, 279.
Juncus diffusus, iv, 323.
Kimberley (Earl of), Birds on the Kimberley estates, ii, 46; iv, 604.
—— Obit., vii, 576.
King's Lynn, Silver Thaw and Glazed Frost in Dec., 1901, vii, 346.
—— Trees broken by Frost, v, 18.
Kirby (W.), iv, 102.
Kirby Bedon, Well at, iv, 44.
Kitton (F.), Address, 1873-4, 7.
—— Diatomaceæ of Norfolk, ii, 336; iii, 754.
—— William Arderon, an old Norfolk Naturalist, ii, 429.
—— On *Empusa musci* and other micro fungi, i, 1873-4, 63.

Kitton (F.) Growth & reproduction in lower plants, i, 1870-1, 49.
—— Spongeous origin of flints, i, 1871-2, 51 ; 1873-4, 81.
—— Memoir, vi, 201.
Kolguev, Flora of, vi, 168.
Lady-birds, plague of, i, 1869-70, 62.
Laemargus microcephalus, iv, 254.
Lagenorhynchus albirostris, iv, 120.
Langmere, vii, 503.
Lanius collurio in Great Britain and Ireland, v, 286.
Lanius meridionalis, viii, 352.
Lanius minor, ii, 209.
Lapland, Flora of, vi, 168.
Larus cachinnans in Norfolk, vi, 417.
Larus melanocephalus, iv, 391.
Larus minutus, i, 1873-4, 82.
Larus sabinei, iii, 373 ; v, 421.
Lastrea cristata, vii, 695.
Lathyrus palustris in England, vii, 467.
Laver (H.), Helix pomatia, viii, 354.
Lean (W.), Bird notes in 1856, vi, 102.
Leach (W. E.), iv, 97, 105.
Leathes (H. M.), *Otis tarda*, iv, 254.
Lena Delta, Birds of, iv, 301.
Leney (F.), Additions to Norwich Museum, (1902), vii, 571 ; (1903), vii, 722 ; (1904), viii, 107 ; (1905), viii, 313 ; (1906), viii, 458 ; (1907), viii, 596 ; (1908), 766.
Lepidoptera of Norfolk, Suppl. to 1873-4, 1 ; iii, 28, 683 ; iv, 691 ; vi, 533.
—— of Switzerland, vii, 445, 674.
—— in W. Suffolk, vi, 111.
—— Breeding in confinement, i, 1873-4, 57.
Lepidopteron, lava of unknown, i, 1869-70, 27.
Lepisma saccharina, tenacity of life, i, 1873-4, 80.
Le Strange (H.), *Brama rayi*, v, 421.
—— Wolferton Wild Birds' Protection Society, vii, 753.
L'Estrange Records, birds in, i, 1870-1, 16.
Letters from :—
—— Browne (Thos.), vii, 360.
Letters from :—
—— Elton (J. W.), ii, 388.
—— Girdlestone (C. S.), ii, 388.
—— Goodall (J.), v, 80.
—— Hamond (Robt.), ii, 388.
—— Hoy (J. D.), ii, 388.
—— Kirby (W.), iv, 102.
—— Leach (W. E.), iv, 98, 105.
—— Le Strange (H.), viii, 175.
—— Lubbock (Rev. Rich.), ii, 388.
—— Marsham (Robt.), ii, 133 ; viii, 175.
—— Marsham (T.), iv, 105.
—— Scales (John), iv, 109.
—— Sheppard (Rev. R.), iii, 386.
—— Smith (E. A.), v, 85.
—— Sowerby (G. B.), iv, 103, 104.
—— Sowerby (J.), iv, 103, 108.
—— Spence (W.), iv, 99, 106.
—— Turner (Dawson), ii, 388.
—— White (Gilbert), ii, 133.
—— Wigham (R.), vii, 299.
—— Wilkin (S.), iv, 101, 106.
—— Yarrell (W.), ii, 388.
Leucobryum glaucum, viii, 537.
Leucochroa candidissima, vi, 418.
License for Shooting in 1554, ii, 614.
Lichens of Norfolk, viii, 117.
Lightning kills birds, viii, 325.
Lilford (Lord), Birds in the Lilford Aviaries, v, 128.
—— Raptorial birds in the Lilford Aviaries, iv, 564.
—— Obit., vi, 232.
Limnology, viii, 159.
Linaria purpurea, iii, 567.
Lincolnshire, Birds of, ii, 555.
Lindley (J.), Mention of, viii, 383.
Linota cannescens, i, 1873-4, 84.
Linton, (E. F.), Flora of Norfolk, iv, 322.
—— Rarer Norfolk plants, iii, 561.
—— Rubi of Norfolk, iv, 496.
—— *Silene inflata*, v, 424.
—— *Trifolium agrarium*, v, 424.
Liparis loeselii, vii, 333, 620 ; viii, 340.
Lithoglyphus from the Weybourne Crag, iii, 503.
Lobelia urens, iii, 424.
Long (F.), Address, 1904, vii, 585.
—— British Assoc. at Dublin, viii, 684.
—— *Cardamine palustris*, vii, 584.

Long (F.), Causes of adventitious Growth on Trees, vii, 617.
—— Flora of Wells, iv, 371.
—— Protection of Wild Plants, vii, 602.
—— Salt-marsh Flora of Wells, viii, 523.
Long (S. H.), Address, 1908, viii, 499.
—— Birds of Handa, viii, 503.
—— Mosquito-Malaria theory, vii, 188.
—— Mosquitoes of Norfolk, vii, 353.
Longe (F. D.), Flints in Chalk, vii, 148.
Lophopus crystallinus, viii, 626.
Lowe (John), *Appendicularia flabellum*, light emitted from, ii, 616.
—— *Argyroneta*, Nest of, ii, 614.
—— Botany in Norway, iv, 630.
—— *Cicindela campestris*, larval habits of, ii, 615.
—— *Clathrocystis aeruginosa*, ii, 227.
—— *Columba œnas*, ii, 613.
—— Fishes of Norfolk, i, 1873-4, 21; iii, 677; v, 634; vi, 495.
—— *Leucochroa candidissima*, vi, 418.
—— *Psyche bombycella*, vi, 418.
—— Rose, fringed calycine leaves of, ii, 616.
—— Sparrow, Plea for, vii, 112.
—— *Turdus torquatus*, migration of, vi, 416.
—— Obit., vii, 578.
Lowestoft, Alien Plants at, vii, 623.
—— Migrants in 1887, iv, 520.
Loxia leucoptera, i, 1872-3, 117.
Lubbock (Rev. Rich.), ii, 392.
—— On Birds of Norfolk, i, 1870-1, 22.
—— Memoir of, ii, 292.
Lucas (C. J.). Obit., vi, 234.
Lucia (—), Notice of, vi, 82.
Ludham, Mollusca at, viii, 855.
Lusciniola schwarzi, in Lincolnshire, vi, 492.
Lutra vulgaris, i, 1872-3, 79.
Lycopodium raising from spores, vii, 96.
Lynn, May Day customs, at, vi, 106.
Macharodus from Kessingland, viii, 624.
Machetes pugnax in winter, vi, 551.
Macpherson (H. A.), Hybrid Finches, iv, 367.
—— Manx Shearwater, iv, 215, 455.
—— *Serinus hortulanus*, iv, 473.
—— Obit., vii, 422.
Macpherson (Jas.), Shiant Isles, iii, 59.
Macrogaster arundinis, iii, 30; vii, 274.
Mammalia of Norfolk, i, 1869-70, 22; 1870-1, 73; ii, 458; iii, 657; v, 632; vi, 493.
—— Extinct, of Norfolk, ii, 279.
—— Sketch of History of Fossil, ii, 504.
Man in Norfolk, ii, 360.
—— Changes in Norfolk due to, iii, 456.
—— Neolithic, in W. Norfolk, v, 250.
—— Neolithic, in Thetford, vi, 23.
Mann (T. J.), Hawks, iv, 650.
—— Obit., vi, 331.
Marsham (Rev. H. P.), Correspondence of R. Marsham and Gilbert White, ii, 133.
—— Obit., v, 232.
Marsham (Rbt.), Indications of Spring, ii, 31; vii, 246.
—— Letters to Gilbert White, ii, 133.
—— Account of severe winter of 1739-40, ii, 125.
—— Life of, viii, 376.
Marsham (Thos.), iv, 104.
Martens in Suffolk in 1811, ii, 223; a correction, vii, 580.
Martes abietum, ii, 611.
Martins, mortality among, i, 1871-2, 62; i, 1869-70, 60.
—— late stay of, i, 1873-4, 84.
—— House, tenacity of life in, iv, 518.
Mascarene Islands, Birds of, iv, 548.
Maurolicus pennanti, v, 109.
May day at Lynn, vi, 106.
Mayfield (A.), Earthworms of Norfolk, v, 574.
—— Mollusca of Norfolk, vi, 185; viii, 783.
—— Mollusca of Mendlesham, Suffolk, vii, 348, 584.

MAYFIELD (A.), Slugs of Norfolk, v, 406.
Meliana flammea, v, 422.
Membranipora monostachys, viii, 498.
Mendlesham Mollusca, vii, 348, 584.
Meres, Wretham, i, 1869-70, 36.
—— Bird-life in the, viii, 747.
—— Origin of, i, 1871-2, 30.
Mergulus alle in Norfolk, vi, 67.
Mertensia maritima in Norfolk, viii, 201.
Mesoplodon bidens on Norfolk Coast, v, 377.
Meterology, (1870-1), 33; (1870-73), 1873-4, 71; (1874), ii, 56; (1875), ii, 217; (1876), ii, 325; (1877), ii, 470; (1878), ii, 602; (1879), iii, 140; 1880), [none]; (1881), [none]; (1882), iii, 505; (1882-3), iii, 566; (1883), iii, 646; (1884), iv, 66; (1885), iv, 230, (1886), iv, 383; (1887), iv, 503; (1888), iv, 668; (1889), v, 96; (1890), v, 219; (1891), v, 313; (1892), v, 411; (1893), v, 592; (1894), vi, 88; (1895), vi, 190; (1896), vi, 273; (1897), vi, 393; (1898), vi, 473; (1899), vii, 54; (1900), vii, 204; (1901), vii, 372; (1902), vii, 528; (1903), vii, 687; (1904), viii, 90; (1905), viii, 239; (1906), viii, 439; (1907), viii, 587; (1908,) viii, 732.
Metton, Well at, vii, 290.
Microzymes, iv, 6.
MIDDLETON (C.), Obit., vii, 585.
Migration other than birds and chiefly of Cetacea, viii, 15.
Mildews, Wheat, vi, 7.
MILLER (S.), Notice of, vi, 81.
Mistletoe, its hosts and distribution in Gt. Britain, vi, 453.
Mollusca of Norfolk, vi, 185; viii, 783.
—— of Suffolk, vii, 348.
—— Land and freshwater of Norfolk, i, 1871-2, 47; vi, 61.
—— marine, of Norfolk, i, 1871-2, 42.
Molorchus minor, vii, 275.
Monodon monoceros in Norfolk, vi, 204.
Moorhen, Hairy variety of, iii, 581.
MORLEY (C.), Coleoptera of Norfolk and Suffolk, vii, 706; viii, 106.
—— Entomology of Hunstanton, viii, 489.
—— Insects of the Breck, viii, 579.
Mosquitoes of Norfolk, vii, 353.
Mosquito-Malaria theory, vii, 188.
Moss (K. M.), Butterflies of Switzerland, vii, 445, 671.
Mosses of Norfolk, vii, 212, 427, 558.
—— of Suffolk, vii, 227, 427.
Motacilla cinereicapilla, ii, 226.
Motacilla neglecta, i, 1872-3, 117.
Motella cimbra, v, 110.
MOTTRAM (J.), Hist. of Norfolk and Norwich Microsc. Soc., vi, 214.
—— Memoir of F. Kitton, vi, 291.
—— Mention of, vi, 219.
Mulberry, vi, 112.
Mundesley, erratics, vii, 7.
—— Well at, vii, 290.
MUNFORD (REV. G.), Obit., 1871-2, 2.
Mus alexandrinus, iii, 419.
Mus rattus at Yarmouth, vi, 229.
Muscicapa parva in Norfolk, v, 197.
Muscicapa parva at Scilly, iv, 688.
Museum, Norwich Castle, additions to, iv, 498; iv, 686; (1889), v, 105; (1890), v, 206; (1891) v, 321; (1892), v, 408; (1894), vi, 84; (1895), vi, 197; (1896), vi, 296; (1897), vi, 390; (1898), vi, 469; (1899), vii, 45; (1900), vii, 171; (1901), vii, 364; (1902), vii, 571; (1903), vii, 722; (1904), viii, 107; (1905), viii, 313; (1906), viii, 458; (1907), viii, 596; (1908), viii, 766.
Mycetozoa of Norfolk, vi, 449.
Myrmica lobicornis, iv, 394.
Naiadaceæ of Norfolk, iii, 379.
Najas marina, iii, 634; v, 426.
Narborough, Insects from, vii, 425.
Nevis, Ben, Life on, vi, 245.
New Zealand, Notes from, i, 1870-1, 90.
NEWBEGIN (J.), Mention of, vi, 218.

Newcome (E. C.), Obit., i, 1871-2, 11.
Newman (Chris.), viii, 380.
Newton (A.), Cranes' bones in the Fens, vii, 158.
—— Great Flood of 1852-3 in S. W. Norfolk, v, 560.
—— Hawking near Yarmouth, iii, 34.
—— Naturalization of *Rana esculenta* in Norfolk, ii, 254.
—— Method of registering Nat. Hist. Observations, i, 1870-1, 24.
—— *Otis tarda*, vii, 113.
—— Memoir of John Scales, iv, 81.
—— Spoonbill in Norfolk in 1300, vi, 158.
—— Memoir, viii, 517.
Newton (Sir E.), Address, 1887, iv, 537.
—— Migrants at Lowestoft, 1887, iv, 520.
—— Memoir, vi, 409.
Newton (E. T.), List of vertebrata from the Forest-bed, iii, 654.
—— Whales in the Forest-bed, v, 425.
Nicholson (W. A.), F. W. Biological Station, vi, 108.
—— Botanical Survey of the Broads, viii, 618.
—— Sir Thos. Browne as a Naturalist, vii, 72.
—— Flora of Norfolk, vii, 748.
—— Flora of Sutton, viii, 265.
—— Variation in *Ranunculus*, vii, 379.
—— Root tubercles, vi, 553.
—— High Tide, 1895, vi, 224.
Nightingale, Notes on (1819), iii, 386.
Niphargus near Norwich, vi, 489.
Nitrogen and Plants, vi, 553.
Nomada succincta, monstrous, ii, 227.
Nonagria cannæ, iii, 31.
Norfolk, Fauna and Flora, of:—
See under group wanted.
— Botan. divisions in, i, 1869-70, 19.
— Names derived from animals and Plants, iii, 212.
— Ornithol. archæology of, i, 1870-1, 14.
—— and Norwich Microscopical Society, Hist. of, vi, 214.
Norgate (F.), Crossbills nesting in Suffolk, iv, 168.
—— Notes on Norfolk Mammalia, ii, 458.
—— Entom. Notes, iii, 383.
—— Nat. Hist. Notes, iii, 68.
—— Nesting of Hobby, iii, 351.
—— Nesting habits of certain Birds, etc., ii, 195.
North Sea, Nat. Hist. of, viii, 5.
North Walsham, Well at, vii, 290.
Northrepps Churchwardens' Accounts, ii, 611.
Norway, Flora of, iv, 630.
—— (S.), Ornithol. Notes, vii, 367.
Norwich Castle Mound, viii, 338.
—— Crag, ii, 377.
Nycterinia capensis, flowering of, vii, 582.
Oak, Winfarthing, ii, 12; vi. 113.
Oaks, list of old, ii, 17.
Observations, registration of, i. 1870-1, 24.
Oglivie (F. M.), *Muscicapa parva*, v, 197.
Ononis repens v. *horrida*, iii, 633.
Ophiodes lunaris, iii, 29.
Orca gladiator, vi, 58.
Orchids of Norfolk, ii, 231.
Oreocincla whitei, i, 1871-2, 65.
Ornithological Notes for (1877), ii, 478; (1878), ii, 594; (1880), iii, 392; (1881), iii, 542; (1882-3), iii. 511.
—— from Cley (1880-81), iii, 345.
—— from Scotland, iii, 517.
Ornithology, i, 1870-1, 14.
Orthagoriscus mola, iii, 70.
Osmerus eperlanus in Norfolk, iv, 338.
Ostrea angulata, vii, 753.
Ostrich Farm, vi, 350.
Otis tarda in Norfolk, ii, 306, 612; iv, 254, 519; v, 656; vii, 113, 328; viii, 727.
Otis tarda in Suffolk, v, 209.
Otis tarda (egg of), iv, 140.
Otter, on the, i, 1872-3, 79.
Otter breeding in November, v, 420.
Oulton Broad, Alien Plants at, vii, 623.
Overend (J. G.), Mention of, vi, 82.
Owl, luminous, viii, 547.
—— Tengmalm's, iii, 424.
Oysters and Starfish, vii, 127.

Pachyprotasis lavicollis, iii, 70.
Paget (C. J.), Mention of, vi, 74.
Paget (Sir James), Obit., vii, 104; mention of, viii, 383.
Palmer (F. D.), Transplanted Mulberry, vi, 112.
—— Old Yarmouth Naturalists, vi, 71.
Pandion haliaetus, i, 1873-4, i, 83.
Panurus biarmicus, vi, 249.
Panurus biarmicus in confinement, iii, 519.
Paradoxocarpus, vi, 328.
Paradoxocarpus carinatus from Forest-bed, v, 382.
Paraselenæ seen at Lynn, 1898, vi, 439.
Partridge laying in Teal's nest, i, 1871-2, 64,.
Parus britannicus, i, 1872-3, 116.
Pastor, Rose-coloured, i, 1871-2, 65.
—— Rose-coloured in Norfolk, 1747, ii, 225.
Patterson (A.), Rare fishes at Great Yarmouth, v, 227, 323.
—— Fishes from Yarmouth, vi, 115, 225, 293, 407, 484.
—— Birds of Yarmouth, vi, 291, 405, 484.
—— John Thomas, Punt-gunner, vii, 339.
—— Nat. Hist. of Yarmouth, vii, 63, 177, 395, 566, 726; viii, 111, 315, 460, 604, 755.
Patterson (A. H.), Fishes of Norfolk, viii, 884.
Peat in Norfolk, viii, 638.
Pelham-Burn (W.), Obit., vii, 421.
Pelican in Cambridgeshire Fens, vi, 363.
Pelias berus, vii, 243.
Pellstart, vii, 612, 613, 614.
Pembrokeshire Birds of vii, 627.
Pernis apivorus, female of, iv, 249.
Pernis apivorus in Suffolk, iv, 416.
Petch (T.), Mollusca (L. & F. W.) of Norfolk, vi, 61.
Petrel, Fulmar, vi, 228
Peucedanum palustre in England, vii, 467.
Pezomachus corruptor, vi, 114.
Phaeton in Herefordshire, vi, 659.
Phalaropus lobatus, i, 1873-4, 83.
Phenology of Norfolk, vi, 337.
Phleum bocknori, viii, 231.
Phoca barbata on Norfolk coast, v, 555.
Phoca hispida on Norfolk coast, i, 1871-2, 20.
Phoenicura tithys, i, 1872-3, 116.
Pholas, v, 79.
Phthoroblastis ochsenheimeriana, iii, 317.
Phylloscopus proregulus, vi, 280.
Pike, see Jack.
Pipit, tawny, vi, 418.
Pitchford (J.), Mention of, ii, 25; vii, 96; viii, 380.
Plant Physiology, vii, 589.
Plants, lower forms of, i, 1870-1, 49.
—— Protection of Wild, vii, 602.
Platalea leucorodia, i, 1873-4, 82.
Plectrophanes lapponica, i, 1871-2, 65; 1872-3, 118.
Plectrophanes nivalis, i, 1873-4, 85.
Plover, Stilt, ii, 208.
Plowright (C. B.), Address, 1895, vi, 1.
——, *Agaricus phalloides*, poisoning by, iii, 152.
—— *Boletus sulphureus* at Brandon, iii, 151.
—— Memoir of D. C. Burlingham, vii, 414.
—— *Corticium chrysanthemi*, viii, 496.
—— British Dye Plants, vii, 386.
—— Ergot on Wheat, 1879, iii, 152.
—— Ergots, iii, 268.
—— Frost, Rime, of January, 1889, v, 18.
—— Fungi of Norfolk, i, 1872-3, 28; iii 730; iv, 728.
—— Fungi found at Brandon, ii, 260.
—— Fungi on Whales' bones, ii, 335.
—— Fungi at Scoulton Mere, ii, 130.
—— *Geaster coliformis*, iii, 266.
—— *Helvella infula* at Brandon, iii, 151.
—— Man, Neolithic, in W. Norfolk, v, 250.
—— May day at Lynn, vi, 106.
—— *Ostrea angulata*, vii, 753.
—— Paraselenae seen at Lynn, 1898, vi, 439.
—— Solar halo and mock sun, vii, 174.
—— Solar halo, vi, 114.
—— *Sparassis crispa*, iii, 267.

Plowright (C. B.), Silver Thaw and Glazed Frost at King's Lynn, Dec., 1901, vii, 346.
—— Woad, vii, 138.
Plowright (C. T. M.), Fulmar Petrel, vi, 228.
—— Black-winged Stilt, vi, 228.
—— Vole, Black var. of Water, vi, 114.
Plumage, Abnormal, iv, 61.
Poehard, " Paget's " i, 1871-2, 66.
Pœciloscytus vulneratus, vi, 419.
Poecilsca nigricana, iii, 316.
Poecilsca proximana, iii, 314.
Poles, Life began at the, iv, 145.
Polyzoa, vii, 133.
Ponds, Nat. Hist. of isolated, v, 272.
Populus fastigiata in Norfolk, iii, 354.
Portugal, Nat. Hist. of, iv, 173.
Potentilla norvegica, iii, 567.
Power (F. D.), Birds from Cley, iii, 345; iv, 186.
—— Ornithology of Cley and Blakeney, iv, 36.
Power (G. E.), Orn. of Cley, iv, 186.
Pratincola rubicola, migration of, ii, 264.
Presidential Addresses: see under person.
Preston (A. W.), Address, 1898, vi, 331.
—— Great Frost of 1890-91, v, 191.
—— Great Frost of 1894-5, vi, 95.
—— Great Gale of March, 1895 vi, 99.
—— Meteorological Notes, (1882), iii, 505; (1883), iii, 646; (1884), iv, 66; (1885), iv, 230; (1886), iv, 383; (1887), iv, 503; (1888), iv, 668; (1889), v, 96; (1890), v, 219; (1891), v, 313; (1892), v, 411; (1893), v, 592; (1894), vi, 88; (1895), vi, 190; (1896), vi, 273; (1897), vi, 393; (1898), vi, 473; (1899), vii, 54; (1900), vii, 204; (1901), vii, 372; (1902), vii, 528; (1903), vii, 687; (1904), viii, 90; (1905), viii, 239; (1906), viii, 439; (1907), viii, 587; (1908), viii, 732,
Preston (E. S.), Mention of, vi, 83.
Priest Island, birds of, iv, 310.
Prosopis, nidification of, 1873-4, 68.
Psyche bombycella, vi, 418.
Puffinus anglorum, iv, 447.
Puffinus griseus at Lynn, in 1851, iii, 474.
Puffinus obscurus in Norfolk (1858), iii, 467.
Purdy (R. J. W.), Luminosity of *Strix flammea*, viii, 547.
Pycraft (W. P.), Ornithol. of Yarmouth, iv, 457.
—— The Bird's wing, vii, 312.
Pyrola minor, ii, 335.
Pyrola rotundifolia in E. Anglia, vii, 512.
Quails, abundance of, i, 1870-1, 90; 1871-2, 61.
Quinton (J. *fil.*), Meteorol. observ. at Norwich, i, (1873-4), 71; (1874), ii, 56; (1875), ii, 217; (1876), ii, 325; (1877), ii, 470; (1878), ii, 602; (1879), iii, 140.
Races, native, extinction by man, iii, 9.
—— by indirect acts of man, iii, 178.
Rainfall, iv, 676.
—— in 19th cent., vii, 260.
Rallus aquaticus, vi, 117.
Ramsey Island Birds, vii, 630.
Rana esculenta ii, 254; iii, 676a.
Ranunculus acris v. *tomophyllus*, iii, 561.
Ranunculus, variation in, vii, 379.
Reid (C.), Norfolk Amber, iii, 601; iv, 144, 247, 395.
—— Chitons from Cromer, iii, 789.
—— Geology of Corton, iv, 606.
—— Forest-bed Seeds, viii, 624.
—— Additions to the Fauna and Flora of the Cromer Forest-bed, iii, 631.
—— Flora of the Forest-bed, iv, 189.
—— *Lithoglyphus* from the Weybourn Crag, iii, 503.
—— Wells at Mundesley, North Walsham and Metton, vii, 290.
— —*Paradoxocarpus carinatus*, v, 382; vi, 328.
—— Nat. Hist. of isolated ponds, v, 272.
Reptiles of Norfolk, i, 1870-1, 81.

Ringmere, vii, 500.
Rising (R). Mention of, vi, 79.
Rooks, pellets cast by, i, 1870-1, 88.
Root tubercles, vi, 553.
Rose (C. B.), Memoir, v, 387.
Rose (Hugh), Mention of, ii, 27 ; viii, 381.
Rose, calyces of, ii, 616.
"The Rosses," Nat. Hist. of, iv, 463.
Rotifera of Norfolk, viii, 137.
—— from Yarmouth, vii, 275, 383.
Rubi of Norfolk, iv, 496.
Ruff, nesting of, iii, 423.
Rules of the Society, i, 1871-2, 68.
Rush candles, viii, 642.
Ruston (East) Common, viii, 631.
Ruticilla phoenicurus, female assuming male plumage, iv, 182.
Ruticilla tithys, 1872-3, 116.
Saffron, iv, 21.
St. Helen's Swan-pit, v, 265 ; vi, 387 ; vii, 579.
Sambucus racemosa, iv, 689.
Saunders (H.), Ornithol. of Spain, i, 1872-3, 16.
—— Memoir of, viii, 522.
Savis (A. C.), Forest-bed, iv, 470.
Scales (J.), Memoir of, iv, 81.
Scales (R.), iv, 97.
Scoloplax albifacies, vi, 154.
Scenery of Norfolk, iii, 439.
Scent, problem of, vii, 277.
Scilly, iv, 447.
—— in the nesting season, iv, 201.
Scleranthus annuus v. *biennis*, iii, 561.
Scleranthus perennis, viii, 528.
Scolopax gallinago, drumming of, iv, 486.
Scopelus mulleri, v, 109.
Scoulton Gullery, i, 1871-2, 22.
—— Mere, Fungi at, ii, 130.
Seal in the Ouse, iii, 422.
——Grey, iii, 415.
Seals and the Seal Fishery, iii, 482.
Seebohm (H.), Address, (1891), v, 111.
—— Birds of North of Alaska, iv, 305.
—— Birds of Lena Delta, iv, 301.
—— Obit., vi, 122.
Senecio in East Anglia, vi, 457.
Serinus hortulanus, habits of, iv, 473.
Serinus hortulanus at Yarmouth, iv, 392.
Seychelles, Birds of, iv, 548.
Shearwater, Manx, habits and plumage of, iv, 215 ; iv, 447 ; iv, 455.
Sheppard (Rev. R.), on the Nightingale (1819), iii, 386.
Shiant Islands, and their bird-life, iii, 47.
—— Geol. and Mineral. of, iii, 61.
Silene inflata, v, 424.
Silene otites, viii, 343.
Simpson (E.), vi, 463.
Skellig Rocks, Bird Life of, v, 40.
Skomer Island Birds, vii, 628.
Skuas on Norfolk Coast in 1879, iii, 99.
Slugs of Norfolk, v, 466.
Smart (Chris.), viii, 380.
Smelt fishery in Norfolk, iv, 338, 481.
Smith (G.), *Fulmarus glacialis*, iv, 223.
—— *Larus melanocephalus*, iv, 391.
Smith (Sir J. E.) on Norfolk Botanists, ii, 25.
—— Notice of, viii, 379.
Smith (John), Notice of, vi, 81.
Snipe, drumming of, iv, 486.
Soar (C. D.), Hydrachnids of the Broads, viii, 83.
Soils of Norfolk, vii, 401.
Solar halo, vi, 113 ; vii, 174.
Somateria spectabilis, a Norfolk bird, v, 58.
Somme Valley, birds of, vi, 444.
Souchus palustris in England, viii, 35.
Sorex fodiens, i, 1872-3, 112.
Sorex remifer, i, 1872-3, 113.
Sothern (S. C.), Life, viii, 646.
Southwell (Thos.), Address, (1880), iii, 1.
—— Address, (1894), v, 509.
—— Agriculture, Rooks and Owls and, vii, 581.
—— *Anguilla vulgaris*, reproduction of, vi, 262.
—— *Arvicola glareolus*, ii, 60.
—— *Balaena biscayensis*, on the E. Coast of Scotland, iii, 228.
—— *Balaenoptera musculus*, ii, 61.

Southwell (Thos.), *Bal. museulus* at Lynn, ii, 222.
—— Flight of Birds, i, 1869-70, 41.
—— Birds, rare, in Norfolk, 1890-91, v, 200.
—— Birds of Norfolk iv, 259, 397; v, 642; vi, 501; vii, 733; viii, 847.
—— Birds, Wild, Protection Acts, vi, 208.
—— Birds, Wild, Protection, viii, 323.
—— Botanists of Norfolk, viii, 374.
—— *Box vulgaris*, vii, 584.
—— Breydon Wild Birds' Protection Society, viii, 496.
—— Browne (Sir Thos.), Letter from, vii, 360.
—— Cetacea, ancient records of, vii, 303.
—— Crane, breeding, in E. Anglia, vii, 160.
—— Curlew, breeding in Norfolk, vii, 276.
—— On the Polish Swan (*Cygnus immutabilis*), ii, 258.
—— Deal fish (*Trachypterus*) on Norfolk coast, iii, 95.
—— Decoys, early, vii, 606.
—— Decoy, Feltwell, vi, 352.
—— Decoys, Norfolk, ii, 538.
—— *Delphinus albirostris*, ii, 333; iii, 149, 421.
—— Diary of 1800-2, Leaves from, vii, 453, 754.
—— Downes (J. D.), Mention of, v, 183.
—— Falconry in Norfolk, v, 183.
—— Fens and Fen-folk, iii, 610.
—— Fisheries, Fresh-water, of Norfolk, iv, 433.
—— Fishes of Norfolk, vii, 741.
—— *Globicephalus melas*, ii, 611.
—— Gurney (J. H.), Memoir of, v, 156.
—— *Halichoerus gryphus* on Norfolk coast, iii, 415.
—— *Halichoerus gryphus* on Breydon, iii, 564.
—— Herring fishery of 1881, iii,, 369; 1882, iii, 539; 1883, iii, 644; 1884, iv, 74; 1885, iv, 239; 1886, iv, 374; 1887, iv, 476; 1888, iv, 682; 1889, v, 86; 1890, v, 211; 1891, v, 310; 1892, v, 403; 1893, v, 578; see Stacy Watson (C.).
Southwell (Thos.), Holkham, Shooting at, v, 379.;
—— *Hyperoodon rostratus*, iii, 476.
—— Irby (L. H. L.), Obit., of, viii, 327.
—— Jack, crowning of, vii, 114.
—— Ladybirds, visitation of, 1869-70, 62.
—— *Lagenorhynchus albirostris*, iv, 120.
—— *Larus cachinnans* in Norfolk, vi, 417.
—— Letters from Hamon Le Strange and Robt. Marsham, viii, 175.
—— *Lycopodium* raising from spores, vii, 96.
—— Mammalia of Norfolk, iii, 657; v. 632; vi, 493.
—— On Marsham's Indications of Spring, ii, 31; vii, 246.
—— Marsham's Journal, ii, 125..
—— *Martes abietum*, ii, 611.
—— *Maurolicus pennanti*, v, 109.
—— *Mesoplodon bidens* on Norfolk coast, v, 377.
—— Meteorological Notes (1882-3), iii, 566.
—— Migration of Cetacea, viii, 15.
—— *Motella cimbra*, v, 110.
—— *Mus alexandrinus*, iii, 419.
—— Museum, Norwich Castle, additions to, (1887), iv, 498; (1888), iv, 686; (1889), v, 105; (1890), v, 206; (1891), v, 321; (1892), v, 408; 1893), v, 581; (1894), vi, 84; (1895), vi, 197; (1896), vi, 296; (1897), vi, 390; (1898), vi, 469; (1899), vii, 45; (1900), vii, 171; (1901), vii, 364).
—— Newton (A), Memoir of, viii, 517.
—— Newton (Sir E.), Life of, vi, 409.
—— Fauna of Norfolk, i, 1870-1, 71.
—— *Orca gladiator*, vi, 58.
—— Ornithological Archæology of Norfolk, i, 1870-1, 14.
—— *Otis tarda*, ii, 612; vii, 328.
—— On the Otter, i, 1872-3, 79.
—— *Phoca barbata*, v, 555.
—— *Phoca hispida* on Norfolk coast, i, 1871-2, 20.
—— Pipit, tawny, vi, 418.

Southwell (Thos.), St. Helen's Swan-pit, v, 265 ;vi, 387 ; vii, 579.
—— Saunders (Howard), Obit., of, viii, 522.
—— *Scopelus mulleri*, v, 109.
—— *Scotophilus* (*Vespertilio*), *discolor*, i, 1873-4, 80.
—— Seals and the Seal Fishery, iii, 482.
—— Smelt Fishery in Norfolk, iv, 338, 481.
—— *Somateria spectabilis*, a Norfolk bird, v, 58.
—— *Sorex fodiens*, i, 1872-3, 112.
—— *Sorex remifer*, i, 1872-3, 113.
—— Species, extinction of by act of man, iii, 69, 178.
—— Sticklebacks as manure, vii, 581.
—— Swan-pits, v, 265.
—— Swan-pit, St. Helen's, vi, 387 ; vii, 579.
—— *Tringa acuminata*, in Norfolk, v, 364.
—— Whale-fishery from Yarmouth and Lynn, viii, 202.
—— Wild-fowl driving in the 16th cent., vii, 90.
Sowerby (G. B.), iv, 103.
Sowerby (James), iv, 108.
Spain, Nat. Hist. tour in, i, 1870-1, 35.
—— Ornithology of, i, 1872-3, 16.
—— and its birds, vii, 701.
—— Trip to, viii, 667.
Sparassis crispa at Cossey, iii, 267.
Sparrows eating Bees, iv, 522.
—— Hybrid, iv, 522 ; v, 660.
—— Plea for the, vii, 112.
Spas of Norfolk, iii, 318, 525, 789.
Species, extinction of by act of man, iii, 69, 178.
—— origin of, ii, 4.
—— names, authority for, i, 1869-70, 121.
Speech, ii, 368.
Spelman (W. W.), *Machetes pugnax* in winter, vi, 551.
Spence (W.), iv, 98, 106.
Spiræa tomentosa, iv, 689.
Spitsbergen, Flora of, vi, 47.
Spoonbill in Norfolk in 1300, vi, 158.
Springs of Norfolk, iii, 318, 525, 789.
Sprowston Churchwardens' Accounts, ii, 488.
Stacy-Watson (C.), *Clupea harengus*, v, 584.
—— Herring fishery of 1894, vi, 53 ; (1895), vi, 147.
—— Obit., vi, 232.
Starfish and Oysters, vii, 127.
Statice reticulata, viii, 231.
Steganoptycha rufimitrana, iii, 317.
Sterna fuliginosa in Suffolk, vii, 752.
Sterna leucoptera, i, 1873-4, 81.
Sterna leucoptera in Norfolk i, 1871-2, 64.
Stevenson (H.), Address, i, 1871-2, 7.
—— *Alcedo ispida*, i, 1873-4, 82.
—— *Limpidis garrulus*, plumage of, iii, 326.
—— *Aquila chrysaetos*, i, 1869-70, 59.
—— on the "Wild Birds' Protection Act," i, 1872-3, 105.
—— *Bombycilla garrula*, i, 1872-3, 119.
—— *Charadrius fulvus*, ii, 214.
—— *Ciconia alba*, i, 1873-4, 82.
—— *Cinclus aquaticus*, i, 1872-3, 114.
—— *Coccothraustes vulgaris*, i, 1872-3, 118 ; i, 1873-4, 84.
—— *Colymbus arcticus*, ii, 66.
—— *Crex baillonii*, ii, 65.
—— Cromer lighthouse, Birds killed at, ii, 66.
—— *Cypselus alpinus* in Norfolk, i, 1872-3, 117.
—— *Grus cinerea*, i, 1869-70, 60 ; 1873-4, 83.
—— Abundance of Little Gulls on Norfolk coast, winter of, i, 1869-70 ; i, 1870-1, 65.
—— *Haliætus albicilla*, i, 1873-4, 81.
—— Heron, Purple, i, 1871-2, 65.
—— Heronries in Norfolk, ii, 64.
—— on L. Hunt's "Birds of Thetford," i, 1870-1, 83.
—— *Lanius minor*, ii, 209.
—— *Larus minutus*, i, 1873-4, 82.
—— *Linota canescens*, i, 1873-4, 84.
—— *Loxia leucoptera*, i, 1872-3, 117.
—— Lubbock (Rev. Rich.), Memoir of, ii, 292.
—— Martins, late stay of, i, 1873-4, 84 ; ii, 65.

Stevenson (H.), Martins, House, tenacity of life in, iv, 518.
—— Meres of Wretham Heath, i, 1869-70, 36.
—— Migrants, winter, in 1874, ii, 67.
—— Migrants, spring, on Breydon, ii, 65.
—— Mortality amongst Swallows and Martins, i, 1872-3, 62; i, 1869-70, 60.
—— *Motacilla neglecta*, i, 1872-3, 117.
—— *Muscicapa atricapilla*, ii, 64.
—— Nightingales, early, ii, 64.
—— *Oreocincla whitei*, in Norfolk, i, 1871-2, 65.
—— Ornithological Notes for (1875), ii, 206; (1876), ii, 306; (1877), ii, 478; (1878), ii, 594; (1878), iii, 120; (1879), iii, 125; (1880), iii, 392; (1881), iii, 543; (1882), iii, 771; (1883), iv, 125.
—— *Otis tarda* in Norfolk, ii, 306.
—— *Otis tetrax* in Norfolk, ii, 67.
—— *Pandion haliaetus*, i, 1873-4, 83.
—— *Panurus biarmicus*, iii, 522.
—— Partridge, French, laying in Teal's nest, i, 1871-2, 64.
—— *Parus britannicus* in Norfolk, i, 1872-3, 116.
—— Pastor, Rose-coloured, i, 1871-2, 65.
—— *Phalaropus lobatus*, i, 1873-4, 83.
—— *Phalaropus hyperboreus*, ii, 65.
—— *Phœnicura tithys*, i, 1872-3, 116.
—— *Platalea leucorodia*, i, 1873-4, 82.
—— *Plectrophanes lapponica*, i, 1872-3, 118.
—— *Plectrophanes nivalis*, i, 1873-4, 85.
—— Pochard, Paget's, in Norfolk, i, 1871-2, 66.
—— *Procellaria glacialis*, ii, 66.
—— Plover, Stilt, ii, 208.
—— *Puffinus griseus* at Lynn in 1851, iii, 474.
—— *Puffinus obscurus* in Norfolk (1858), iii, 467.
—— Quails, abundance of, i, 1870-1, 90; 1871-2, 61.
Stevenson (H.), Pellets cast by Rooks, 1870-1, 88.
—— *Scolopax*, drumming of, iv, 486.
—— on Scoulton Gullery, i, 1871-2, 22.
—— *Serinus hortulanus* at Yarmouth, iv, 392.
—— Skuas on the Norfolk coast in 1879, iii, 99.
—— Snipe, ii, 66.
—— *Sterna leucoptera* in Norfolk, i, 1871-2, 64; 1873-4, 81.
—— *Surnia nyctea*, i, 1872-3, 114.
—— Swallows, late stay of, i, 1873-4, 84; ii, 65.
—— Swift, late stay of, ii, 65.
—— *Totanus ochropus*, i, 1873-4, 84.
—— *Turdus pilaris*, early appearance of, i, 1873-4, 83; ii, 65.
—— Waxwing, plumage of, iii, 326.
—— Woodcocks, ii, 66.
—— Woodcocks nesting, i, 1872-3, 115.
—— *Xema sabinii* in Norfolk, iii, 373.
—— Obit., iv, 560.
Sticklebacks as manure, vii, 581.
Stillingfleet (B.), Notice of, viii, 376.
Stilt, Black-winged, vi, 228.
Stilts, Colony of Black-winged, iv, 462.
Stone Age, viii, 393.
Stones, precious, vii, 15.
Stratiotes aloides, viii, 181.
Stratiotes aloides, fossil, vi, 328.
Strix flammea, luminosity of, viii, 547.
Sturgeon in the Ouse, iii, 422.
Subsidences in Norfolk, iii, 637.
Suffolk, Coleoptera of, vii, 706.
—— Fungi, viii, 246.
—— Mammalia, i, 1869-70, 22.
—— Mosses of, vii, 227.
Sugars, varieties of, iv, 25.
Sun, mock, vii, 174.
Surnia nyctea, i, 1872-3, 114.
Surnia nyctea at South Repps, i, 1871-2, 63.
Sutton (Chas.), mention of, viii, 382.
—— vii, 453, 754.

Sutton (F.), Address, iv, 1.
—— Protective instinct in Fishes, vi, 440.
—— On Sugars, iv, 25.
—— Well at Kirby Bedon, iv, 44.
Sutton Broad, Flora of, viii, 265.
Sutton Broad Laboratory, vii, 731.
Swallows, late stay of, i, 1873-4, 84.
— — mortality among, i, 1871-2, 62; i, 1869-70, 60.
Swan-pits, v, 265.
Swan-pit, St. Helen's, vi, 387; vii, 579.
Symbiosis, iii, 432.
Syrphidæ, swarm of, i, 1869-70, 63.
Taylor (J. E.), Norfolk Broads and Meres geologically considered, i, 1871-2, 30.
Taylor (S. T.), Address, 1890, v, 1.
Teasdel (H.), Mention of, vi, 82.
Teasel in Norfolk, use of, vii, 147.
Tellina balthica, ii, 377.
Tern, Caspian, iii, 565.
Teucrium scordium, vii, 333.
Therapha hyoscyami, vii, 427.
Thetford, Birds of, i, 1870-1, 83.
—— Nat. Hist. of, viii, 386.
—— Vertebrata of, vi, 300.
Thomas (John), vii, 339.
Thomson (D. G.), Tame Hare, viii, 540.
Thompson (J. V.), works of, vii, 121.
Thompson (W. E.), Coast Flora of Norfolk, vii, 514.
Thouless (H. J.), Insects from Narborough and Walton Common, vii, 425.
—— *Melorchus minor*, vii, 275.
—— *Therapha hyoscyami*, vii, 427.
Thrincia tuberosa, iv, 143.
Thrush and Blackbird interbreeding, iii, 588; iv, 582.
Thrush tribe in England, iv, 619.
Tide, High, in 1895, vi, 224.
Todd (J. T.), Nat. Hist. Notes from Churchwardens' Accounts, ii, 488.
Tomlinson (J.), Mention of, vi, 83.
Tortoises, iv, 316; v, 368.
Tortricidæ at Merton, iii, 313.
Torula, i, 1870-1, 50.
Tostock, Hymenoptera of, vii, 13, 156, 330.
Totanus ochropus, i, 1873-4, 84.
Trachinus draco, poisoned spines of, viii, 355.
Trachypterus arcticus on Norfolk coast, iii, 95.
Trees broken by frost, v, 18.
—— causes of adventitious growth on, vii, 617.
—— washing of, vi, 552.
Trifolium agrarium, v, 424.
Trimmer (Kirby), viii, 384.
Tringa acuminata in Norfolk, v, 364.
Triphæna subsequa, iii, 69.
Tuck (J. G.), *Otis tarda* in Suffolk, v, 209.
— — *Uria brünnichi* in Cambridgeshire, vi, 109.
Tuck (W. H.), Coleoptera of Suffolk, v, 661.
—— Eels growth, v, 660.
—— Entomol. Notes, vii, 526, 635.
—— Hymenoptera at Tostock, vi, 27, 328, 419, 554; vii, 13, 156, 330.
— Hymenoptera of Suffolk, vi, 36.
—— Lepidoptera in W. Suffolk, vi, 111.
Turdus pilaris, early appearance of, i, 1873-4, 83.
Turdus torquatus, migration of, vi, 416.
Turner (Dawson), ii, 392; vi, 76.
Turner (Miss E. L.), Coot, and Great Crested Grebe, viii, 449.
Upcher (H. M.), Address (1884), iii, 569.
—— Birds-nesting in Norfolk, iv, 679.
Uria brünnichi in Cambridgeshire, vi, 109.
Vanessa antiopa, i, 1872-3, 24.
Veronica triphyllos, viii, 528.
Veronica verna, iii, 268; viii, 528.
Vespa vulgaris, nest of, iv, 50.
Vespertilio discolor, i, 1873-4, 80.
Vipers, ii, 613.
Vole, water, black var. of, vi, 114.
Wagtails, hybrid, iv, 521.
Waller (J. G.), Woad in 1265, viii, 497.
Wallis (H. M.), Nat. Hist. of Arran More and "The Rosses," Donegal, iv, 463.

Walsingham (Lord), Pholas, v, 79.
—— Rare Tortricidæ at Merton, iii, 313.
Walter (J. H.), Egyptian Ostrich Farm, vi, 350.
Walton Common, Insects from, vii, 425.
Warblers, rare European, vi, 280.
Water-hen's nest made of Peacock's feathers, vi, 552.
Water-spout off Tunis, i, 1871-2, 66.
Waxwing, plumage of, iii, 326.
Ways, Hollow, v, 419.
Weather, register of, i, 1870-1, 33, (see Meteorology).
Well at Kirby Bedon, iv, 44.
Wells, Flora of, iv, 371 ; viii, 523.
—— Wild Birds' Protection Society, viii, 623, 853.
West Digges Island, Flora of, iv, 354.
Whale-fishery from Yarmouth and Lynn, viii, 202.
Whales in Forest-bed, v, 425.
Wheeler (F. D.), Address, 1892, v, 232.
—— Breeding Lepidoptera in confinement, i, 1873-4, 57.
—— Memoir of C. G. Barrett, viii, 152.
—— Entomological Notes (1880), iii, 262.
—— Lepidoptera in Norfolk in 1878, iii, 28.
—— *Macrogaster arundinis*, vii, 274.
—— *Meliana flammea*, v, 422.
Wheler (E. G.), Marked Woodcocks, vi, 416.
—— *Pœciloscytus vulneratus*, vi, 419.
Whitaker (J.), Abnormal Plumage iv, 61.
White (Gilbert), Letters to Marsham, ii, 133.
Whitear (Mary), Extracts from Rev. W. Whitear's Calendar, iii, 231.
Whitear (Rev. W.), Extracts from his Calendar, (1809-1819), iii, 231.
—— Memoirs of, iii, 232.
Whitty (E. R.), Obit., viii, 329.
Wigg (Lilly), Memoir of, ii, 269 ; vi, 73 ; viii, 380.
Wigg (T. J.), Herring fishery, (1899), vii, 49 ; (1900), vii, 262 ; (1901), vii, 354 ; (1902), vii, 536 ; (1903), vii, 682 ; (1904), viii, 97 ; (1905), viii, 307 ; (1906), viii, 455 ; (1907), viii, 599 ; (1908), viii, 763,
Wigham (Robt.), Memoir of, vii, 298.
Wild-fowl driving in the 16th cent., vii, 90.
Wilkin (S.), iv, 101.
Williams (Chas.), Obit., viii, 499.
Winfarthing Oak, ii, 12 ; vi, 113.
Wilson (—), botanist of Norwich, ii, 26 ; viii, 380.
Wing of Bird, vii, 312.
Winter of 1739-40, ii, 125.
Woad, v, 144 ; vii, 138.
—— in 1265, viii, 497.
Wolferton Wild Birds' Protection Society, vii, 753 ; viii, 493, 852.
Woodcocks drowned while migrating, ii, 488.
—— abundant in 1908, viii, 856.
—— marked, vi, 416.
—— nesting, i, 1872-3, 115.
Woodpecker, Great Black, vii, 737.
Wood-pigeons, flights of, vii, 427.
Woodward (Hy.), Address, 1903, vii, 429.
—— East Anglian Geology, vii, 477.
Woodward (H. B.), Address, 1893, v, 333.
—— the Earthquake of April, 1884, iv, 31,
—— Earthquakes and subsidences in Norfolk, iii, 637.
—— *Emys lutaria* in Mundesley river bed, iii, 36.
—— Memoir of C. B. Rose, v, 387.
—— Scenery of Norfolk, iii, 439.
—— Soils and subsoils of Norfolk, vii, 401.
—— Memoir of S. C. Sothern, viii, 616.
—— Springs and Spas of Norfolk, iii, 318, 525, 789.
—— Hollow Ways, v, 419.
—— Life of S. P. Woodward, iii, 279, 424.
—— Memoir of Sam. Woodward, ii, 563.

Woodward (Samuel), Memoir of, ii, 563.
Woodward (S. P.), Life of, iii, 279, 424.
Woodward (T. J.), viii, 381.
Wretham Meres, i, 1869-70, 36; vii, 499.
Wright (C. A.), Obit., viii, 500.
Xanthidia in flint, i, 1870-1, 55.
Xema sabinii in Norfolk, iii, 373; v, 421.
Yarmouth Nat. Hist. of, vii, 63, 177, 395, 566, 726; viii, 111, 315, 460, 604, 755,
Yarmouth Ornithol. of, iv, 457.
—— Pond Life, vii, 755.
Yarrell (W.), letters of, ii, 413.
Youell (—), Mention of, vi, 81.
Young (J.), Arran More, iv, 677.
—— Heronry on the Danube, iv, 170.
—— *Panurus biarmicus* in confinement, iii, 519.
—— Colony of Black-winged Stilts iv, 462.
—— Obit., vii, 422.

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CONTENTS.

	List of Officers	v
	List of Members	vi
	Statement of Accounts	x
	Catalogue of Additions to the Library . .	xi
	President's Address	627
I.	A Trip to Spain. By Miss M. L. Buxton . .	667
II.	A Week in Breckland. By W. G. Clarke . .	677
III.	With the British Association at Dublin. By F. Long, L.R.C.P.	684
IV.	East Anglian Plants. By A. Bennett, F.L.S. .	687
V.	*Deschampsia setacea*, Richter, a little known Norfolk Grass. By Arthur Bennett . . .	694
VI.	Natural History Experiences in British East Africa. By Gerard H. Gurney, F.Z.S. . . .	696
VII.	The Great Bustard. By E. J. H. Eldred . .	727
VIII.	Meteorological Notes, 1908. By Arthur W. Preston, F.R. Met. Soc.	732
IX.	Bird-life of the Meres. By W. G. Clarke . .	747
X.	Natural History Notes from Yarmouth. By Arthur H. Patterson	755
XI.	Notes on the Herring Fishery of 1908. By T. J. Wigg	763
XII.	Some Additions to the Norwich Castle-Museum in 1908. By Frank Leney	766
XIII.	The Algæ of Suffolk. By Rev. E. N. Bloomfield, M.A.	768
XIV.	Fauna and Flora of Norfolk: The Non-Marine Mollusca of Norfolk. By A. Mayfield . .	783
XV.	Fauna and Flora of Norfolk: Marine Algæ. By Rev. E. N. Bloomfield, M.A. . . .	809
XVI.	Fauna and Flora of Norfolk: Sawflies. By Rev. E. N. Bloomfield, M.A., F.E.S., with the assistance of Mr. E. A. Atmore, F.E.S. . . .	810
XVII.	Fauna and Flora of Norfolk: Hymenoptera. By E. A. Atmore, F.E.S.	821
XVIII.	Fauna and Flora of Norfolk: Coleoptera. By James Edwards, F.E.S.	826
XIX.	Fauna and Flora of Norfolk: Hemiptera. By James Edwards, F.E.S.	840
XX.	Fauna and Flora of Norfolk: Fishes. By A. H. Patterson	844
XXI.	Fauna and Flora of Norfolk: Birds. By J. H. Gurney, F.L.S., and T. Southwell, F.Z.S. .	847
XXII.	Miscellaneous Notes and Observations . .	852
	Title Page and Index to Vol. viii.	
	Index 1869—1908.	